TECHNOLOGY INVENTORY-IV

RESEARCH ACCOMPLISHMENTS AND RECOMMENDATIONS

(2020 - 2025)

University Released Varieties & Farm Machineries

Edited by

Dr. V. K. Kharche

Dr. A. K. Sadawarte **Dr. P. P. Bhople**

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DIRECTORATE OF RESEARCH

DR.PANJABRAO DESHMUKH KRISHI VIDYAPEETH

AKOLA - 444 104 (Maharashtra)

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Dr. Sharad R. Gadakh
Vice Chancellor
Dr. PDKV., Akola

Foreword

It is my great pleasure to present "Research Accomplishments 2020-2025," a compendium of multidisciplinary technologies developed and recommended by the exemplary scientists of Dr. Panjabrao Deshmukh Krishi Vidyapeeth. This body of work is a testament to our commitment to uplift the farming community across the diverse agro-ecological landscape of the eleven districts comprising the Vidarbha region of Maharashtra.

As the impacts of climate change become increasingly evident, our agricultural practices must adapt to safeguard food security, a critical concern as population pressures mount and the global scenario shifts. This publication encapsulates innovations in crop improvement, production, protection, horticulture, animal husbandry, social sciences, and agricultural engineering that have emerged in response to the challenges posed by climate change.

Recognizing the importance of resilience, we have developed crop varieties that can thrive under changing climatic conditions, ensuring sustained productivity and a secure food future. Alongside these advancements, we are also mindful of the challenges posed by a dwindling labor force in agriculture. In response, we have engineered farm implements and machinery that promote mechanization, thus maximizing efficiency and productivity.

Furthermore, the judicious management of our valuable natural resources has become paramount. In this publication, you will find an array of useful technologies aimed at promoting sustainable practices that will benefit farmers while preserving the environment.

I extend my heartfelt congratulations to Dr. Vilas Kharche, Director of Research and the dedicated team of scientists whose relentless pursuit of excellence has made these advancements possible. Their unwavering commitment to the advancement of agriculture serves as an inspiration to us all.

I trust that this publication will serve as a vital resource, providing farmers with an updated, commodity-wise package of practices tailored for the unique conditions of the Vidarbha region. By adopting these technologies, we can not only enhance agricultural productivity but also significantly improve the livelihood security of our farmers.

Let us continue to strive for a sustainable agricultural future, where science and community work hand in hand for the benefit of all.

Akola
Date: 31/05/2025

(Sharad R. Gadakh)

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

PREFACE

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 in 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. These efforts are supported by strong collaborations with officials from the State Department of Agriculture, Horticulture, and Animal Husbandry, as well as NGOs and farmers. This multi-faceted approach allows for effective on-station and on-farm research and development (R&D), leading to improved productivity and profitability of niche crops while simultaneously reducing cultivation costs. Research outcomes are systematically compiled and shared, with publications such as "Research Accomplishments 2020-2025" highlighting the significant advancements made.

I commend the coordinators and conveners of various Sub-Committees within the Agricultural Research Review Committees of Dr. PDKV, Akola, alongside the dedicated scientists whose efforts have been critical in generating these technologies. The technologies and findings presented are designed to aid farmers in sustaining their agricultural practices amidst various challenges.

I would also like to extend my gratitude to Hon'ble Vice Chancellor for his unwavering support and guidance in this endeavour. The Vidarbha region faces pressing issues, including climate change impacts, labour shortages, evolving consumer behaviors, pest and disease outbreaks, declining groundwater levels, land degradation, and rising input costs. The ongoing research aims to tackle these emerging challenges by developing innovative technologies that not only reduce cultivation costs but also promote resource conservation for optimal agricultural productivity.

The main focus of the research during this period was to develop climate resilient varieties and technologies. Accordingly the need based research programme taking into consideration the demands of farmers and prevailing agroclimatic conditions was planned and executed. These agrotechnologies compiled in this book are the results of this mission mode research work. I congratulate the devoted team of scientists in the University for this commendable work which is going to help a long way to farming community.

Akola

Date : 31/05/2025

(V. K. Kharche)

CONTENTS

1. 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 and PG college and Agriculture Research Stations in Vidarbha region. The research accomplishments during 2020 to 2025 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, soyberan, sorghum, pigeonpea, 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 international institutes like FiBL, Switzerland, Solidaridad, Netherlands, Ecocert, France, Cotton Connect (South Asia), Pvt. Ltd., London (UK) and Environmental Defense Fund, USA for research, education and extension and national institutes like Department of Biotechnology, New Delhi, Rajiv Gandhi Science and Technology Commission, Govt. of Maharashtra (RGSTC), Mumbai, BARC, Mumbai, ICRISAT, Hyderabad and ICAR institutes, etc. The university has 24 All India Coordinated Research Projects funded by the ICAR. The strategic research programmes are also being undertaken through agriculture research stations spread all over Vidarbha region, 20 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 1979 technologies covering various areas including 195 crop varieties/hybrids and 64 farm implements and machineries that have been developed for the benefit of farmers of the region. The different important and adopted technologies include 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.

Inventory - IV

During the last six years (2020 to 2025), 369 technologies have been recommended by the university including crop varieties/hybrids & farm implements for the benefit of farming community. The 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-ordinator 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.

Table 1: Recommendations approved by the Joint Agresco Committees of SAUs for the benefit of farmers (2020 to 2025)

S.N.	Name of JOINT AGRESCO Sub Committee	Number of Recommendations
1	Natural Resource Management	85
2	Horticulture	50
3	Agroforestry	05
4	Animal Science and Fisheries	09
5	Basic Sciences, Food Science and Bio Technology	06
6	Organic Farming	02
7	Plant Protection	47
8	Agril. Engineering	63
9	Social Science	46
10	Variety Release Committee for Field Crops	18
11	Variety Release Committee for Horticultural Crops	06
12	Farm Implement Release Committee	32
	Total	**369**

In Joint Agricultural Research and Development Committee meeting (Joint Agresco) at state level, there are various discipline wise sub committees, where in Co-ordinators present the recommendations, those are finalized and accepted for release at state level. During 2020 to 2025, in total 369 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 in Table 1. These technologies will go a long way in helping the farmers to enhance the productivity and sustainability of agriculture.

2. RESEARCH ACCOMPLISHMENTS

Crop Improvement (2020 to 2025)

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

2.1 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.

Year : 2020

Field crops

Under field crops, during 2020, Rice variety PDKV RED RICE 1 and Groundnut variety - TAG 73 were released.

Rice : Variety - PDKV RED RICE 1

- It is red rice variety.
- Yield : 40-45 q/ha in Vidarbha region.
- Duration Midlate : 137 days (130 to 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 and Zinc 23.19 µg/g grain dry weight of unpolished rice.
- Moderately resistant to leaf blast, leaf scalds and stem borer.

Groundnut : Variety - TAG 73

- Yield: 24-28 q/ha.
- 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.

Inventory - IV

Horticulture crops

Vegetable crops

Under vegetable crops Cowpea Variety - PDKV Rutuja was released.

Cowpea : Variety - PDKV Rutuja

- Yield of green pods: 80-85 q/ha.
- 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

Year : 2021

Field crops

Under field crops, during 2021, Rice variety PDKV Sadhana and Rabi Hurda Sorghum variety Trombay Akola Suruchi (TAKPS-5) were released.

Rice : Variety - PDKV Sadhana (SKL-3-1-41-8-33-15)

- Average grain yield: 5000 kg/ha in Vidarbha region.
- Duration : Early (118-120 days).
- Dwarf stature 99 cm (91-106 cm).
- Long slender grains with 1000 grain weight 25.7 g.
- Milling 71.70 %, Good head rice recovery (55.74%) with intermediate AC (24.28 %), good cooking and eating quality.
- PDKV Sadhana is recommended in Vidarbha region under transplanted condition for *Kharif* season.

Rabi Hurda Sorghum : Variety- Trombay Akola Suruchi (TAKPS-5)

- Green hurda yield: 40-41q/ha.
- Green fodder yield: 115 q/ha.
- Duration: 90 – 95 days.

- Hurda of TAKPS 5 is of high quality & sweet in taste.
- Resistant to stem borer & stem fly.
- TAKPS 5 is recommended for rabi season.

Year : 2023

Field crops

Under field crops, during 2023, Maize variety PDKV Aarambha (ABMH 18-2) and Foxtail millet variety PDKV Yashshree (BFTM – 82) were released.

Maize : Variety - PDKV Aarambha (ABMH 18-2)

- Yield:101.63 qt/ha.
- Duration: 95-100 days.
- Medium Maturity.
- Suitable for rainfed condition.
- Moderately resistant to Turcicum leaf blight disease.

Foxtail millet : Variety - PDKV Yashshree (BFTM – 82)

- Yield : 23.34 qt/ha.
- Duration: 81-85 days.
- Attractive yellowish grains.
- Compact panicles.
- Tolerant to Blast and Rust disease.

Sunflower : Variety - PDKV Suraj (PDKVSH 964)

- Yield : 18-22 qt/ha
- Oil percent: 37-38 %
- Belongs to medium maturity duration (matures in 89-90 days)
- Blackish seed with elongated shape
- Moderately resistant to Alternaria and leaf hopper.

Inventory - IV

Horticulture crops

Under horticulture crops, wood apple variety PDKV Pratap AKWa-1402 and Garlic genotype PDKV Purna (AKG-07) were released.

Fruit crops

Wood apple : Variety - PDKV Pratap AKWa-1402

- Regular bearer
- Average fruit wt : 489 g
- Bigger size of fruits
- More number of fruits /tree : 347
- Higher pulp content – 66.27%

Vegetable crops

Garlic : Genotype PDKV Purna (AKG-07)

- Yield - 119.62 q/ha.
- Bulbs- Bright white coloured and 21g average bulb weight.
- Suitable for medium maturity group (130 to 135 DAP).
- Longer storability with minimum storage losses (11.15 %).
- Moderately tolerant to thrips and resistant to purple blotch.

Year : 2024

Field crops

Under field crops, during 2024, chikpea variety PDKV super JAKI (AKG-1402), rice variety PDKV Sakshi, mustard variety PDKV Kartik (ACN –237), Safflower variety PDVK white (AKS 351) and little millet variety PDKV Tejashree (BLM – 18-21) were released.

Chikpea : Variety - PDKV super JAKI (AKG – 1402)

- Yield – 20.73 q/ha .
- Maturity – 98 days
- Early and Synchronous
- Maturity.
- Bold seeded
- Suitable for Mechanical Harvesting.
- Resistant to moderately resistant for wilt disease.

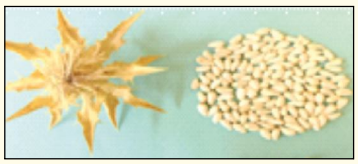
Rice : Variety - PDKV Sakshi (SKL-10 -15- 593 - 162 - 25 - 106 – 70)

- Average yield – 44 q/ha
- Early duration – 120 days
- Long slender grains, with good cooking and eating quality, dwarf stature non lodging .
- Nutritionally enriched (Zinc - 25 ppm and Iron 10 ppm) in polished rice.
- Moderately resistant to stem bores, blast and glume discolouration.

Mustard: Variety - PDKV Kartik (ACN237)

- Seed yield – 15 kg/ha.
- Oil content – 40.32%.
- More siliquae density on main stem and seeds per siliqua.
- Comparable with checks for Aphid and Powdery Mildew Reaction.

Safflower : PDVK white (AKS 351)



- High yielding potential of 18 – 22 q/ha.
- Oil content 28-33%.
- Medium to late duration and matures in 136 – 140 days.
- Boldness and bright white colour of seed.
- Tolerant to aphid and moderately resistant to Alternaria leaf spot.

Little Millet : PDKV Tejashree (BLM – 18-21)

- Yield - 22.63 q/ha.
- Medium to late maturity.
- For kharif season in Maharashtra.
- Tolerant to major pest and disease.

Inventory - IV

Horticulture crops

Under horticulture crops, Gladiolus variety PDKV Satpuda Parpul (NG-6) was released.

Flower crops

Gladiolus genotype PDKV Satpuda Parpul (NG-6)

- More spike yield (2.77 lakh per ha)
- More number of corms (2.59) per plant
- Attractive purple petals with dark violet streaks in throat on lower petals
- Long straight spike (105.80 cm)
- More number of florets (15.50) per spike
- More vase life (10.38 days)
- Moderately resistant to fusarium wilt disease.

Year : 2025

Field crops

Under field crops, during 2025, Sorghum variety PDKV Shashvat, Finger millet PDKV Adhishree, Mung PDKV Phalguni, PDKV Varsha, Chichpea PDKV Kabuli-5 and Linseed PDKV Sharda were released.

Sorghum (Rabi) : PDKV Shashvat (AKASV 461 R)

- Grain yield: 31.8 q/ha.
- Fodder yield: 78.66 q/ha.
- Good Roti quality and Organoleptic quality.
- Moderately resistant to shoot fly and stem borer.
- Moderately resistant to charcoal rot, rust and leaf blight diseases.
- Released for Rabi rainfed areas of Maharashtra.

Finger millet : PDKV Aadishree (BFM 8-E)

- Grain yield: 31.8 q/ha.
- Early maturing variety (100-105 days).
- It is moderately resistant to leaf blast and brown spot disease
- Released in Maharashtra for *Kharif* season.

Mung (Zaid) : PDKV - Phalguni (TAKSM-140)

- Yield: 9.09 kg/ha.
- Suitable for summer cultivation in Maharashtra.
- Matures in 70 days with synchronous maturity.
- Attractive and shiny bold seeds.
- 5.62 g per 100 seed weight.
- Resistant to yellow mosaic virus disease.

Mung : PDKV-Varsha (TAKM-141)

- Yield: 1076 kg/ha.
- Top bearing for easy pod picking
- Medium Bold seed type with non-shattering pods.
- Resistant to yellow mosaic virus disease.

Chickpea : PDKV Kabuli-5 (AKGK1801)

- Yield: 2067 kg/ha.
- Early and synchronous maturity (104 days).
- Tall and erect in growth habit and suitable for mechanical harvesting.
- Bold seeded (45 g per 100 seed wt.)
- Resistant to Fusarium wilt.

Linseed : PDKV Sharda (PDKV ANAL 371)

- Yield: of 1019 Kg/ha.
- Oil content: 37.5%.
- Moderate resistance to linseed bud fly and wilt.

Horticulture crops

Under horticulture crops Khirni variety PDKV Adhar and Custard apple variety PDKV Sangam was released.

Khirni : PDKV-Aadhar (MGK-31)

- Yield: 22.50 Kg/tree.
- Excellent rootstock for Sapota grafting.

- Maximum Seed Germination.
- Early Germination.
- High Seedling Vigour.
- High Survival Percentage.
- Good Graft Compatibility with Scion.

Custard apple : PDKV-Sangam (CA-12-03)

- Bigger fruit size: 11.91 cm (Equatorial diameter) 12.79 (Polar diameter)
- Fruit yield: 19.89 kg/tree.
- Average fruits/tree: 62.81.
- Average fruit wt: 316.71 gm.
- Pulp content: 63.11 %.
- High TSS: 24.98^{o}B.

2.2. Farm Implements/Machineries (2020 to 2025)

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 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. University has developed many farm implements, machineries, post harvest technologies and released for their use by the farming community in the agriculture.

Year : 2020

Lathyrus dal mill Plant

For milling of lathyrus in one pass PDKV Lathyrus dal mill plant is recommended for release.

- Lythyrus dal obtained in one pass
- Capacity of the machine is 150-200 kg/h & efficiency is 78 %.
- The machine can separate Dal, Gota, powder, brokens, husk by mechanical means.
- Machine is easy for handling

Biomass hot air rotary dryer

It is recommended to use PDKV Biomass air heating system for drying of agricultural produce

- The capacity is 2 quintal 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 quintal.
- 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

Year : 2021

Tractor Operated Offset Road Side Grass Cutter

It is recommended to use PDKV developed tractor operated offset road side grass cutter for removing weeds, grasses and unwanted planted along road side and field boundaries

- The implement can be used to cut road side grass, weeds and unwanted plants.
- The cutting efficiency of this implement was found to be 90.21 to 93.13 %.
- Fuel efficiency was found to be 4.22 to 4.30 l/h.
- The average width of cut of tractor operated offset road side grass cutter was found 72 cm.
- The range of forward speed of tractor operated offset road side grass cutter was found 2.10-2.25 ha/h.
- The range of field efficiency of tractor operated offset road side grass cutter was found 75.28 to 83.90 %.
- Capable to cut 10-15 cm diameter unwanted plants.

Inventory - IV

PDKV Bullock Drawn Puddler

PDKV bullock drawn puddler is recommended for puddling operation of paddy (rice) field in sandy loam soil of Eastern Vidharbha

- PDKV developed bullock drawn puddler used for puddling of Paddy field.
- Green manure or weeds are completely buried in the mud.
- This machine is operated with the help of a pair of bullocks and the machine does not get stuck in the mud during the puddling.
- The field capacity was found 0.176 ha/hr and efficiency is 70.45 %.
- Puddling Index is 39.50%.

PDKV Sorghum *hurda* extraction machine for tender sorghum

PDKV Sorghum hurda extraction machine is recommended to release for sorghum hurda extraction.

- Useful for extraction of hurda from green sorghum kernels.
- The hurda extraction capacity is 180 kg/h.
- The machine is operated on 1 horse power motor.
- The hurda extraction efficiency is 93 %.
- Damage of hurda is minimal during extraction.
- The belt clearance can be adjusted as per the size of sorghum kernel.
- Operational cost of machine is less and easy for handling.

PDKV Chironji nut (*Buchanania lanzan*) Grader cum Decorticator

PDKV Chironji nut Grader cum Decorticator is recommended for grading and decortication of chironji nut.

- Two important operations grading and decortication can be simultaneously performed by using this machine.
- The mechanism consist of Grader unit with grading efficiency of 98.81%.
- The mechanism consist of Decorticator unit with decorticating efficiency of 92.89%.
- The weight of the machine is 75 kgs and is portable.
- The developed Chironji nut Grader cum Decorticator assures the safety of the operator.

- The mechanism was portable, thus, would be easily shifted / transported from one place to another.
- Even an unskilled labour was able to easily operate the developed decorticator.
- The easy mechanism helps to reduce the processing cost and maintenance cost.
- The developed Chironji nut Decorticator would help the cooperative farmers, tribal people, small, medium and large scale farmers, self help groups (SHG), bachat gats, unemployed youths to become an entrepreneur.

PDKV wet red chilli seed extractor

PDKV wet red chilli seed extractor (capacity - 300 kg/h) is recommended for extraction seed from wet red chillies.

- Capacity of the machine is 300 kg/h
- The seed extraction efficiency is 95-97 %.
- Power requirement of machine is 3 phase, 3 hp electric motor.
- Seed extraction machine is useful for seed growers.
- No effect on seed germination.
- The machine is easy to operate.
- An unskilled person can operate this machine.

Year : 2022

PDKV developed cotton stubble uprooter

- Cotton stalks shredding, stubbles uprooting and strip ploughing these three operations are performed in a single pass of tractor.

- Two rows are covered by the developed cotton stubble uprooter attachment and maximum field capacity of 0.351 ha/h was observed and which was higher than that of commercially available shredder cum uprooter.
- The depth of operation of 200 mm was found sufficient to uproot almost cent percent cotton stubbles
- Saving in cost of operation was observed 30.06 % over the traditional practice of cotton stalks uprooting by tractor operated V-blade.

Inventory - IV

PDKV developed groundnut harvester

- It save the labors and time for harvesting of groundnut crop.
- The average field capacity of groundnut harvester is 0.059 ha/h.
- Average pod damage percentage was found 4.77%.

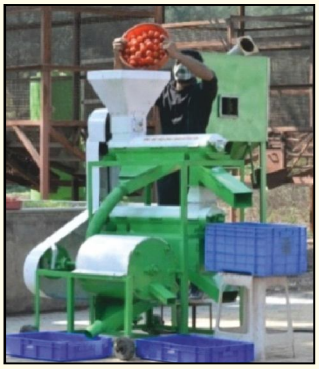
PDKV developed two row belt type cotton planter

- This planter is suitable for planting of cotton seeds precisely at 45 cm and 30 cm seed to seed spacing.
- There 79.48 per cent saving in cost of operation over traditional method of manual dibbling.
- The average effective field capacity of the planter was found as 0.43 ha/h. and time required to cover one hector was found to be 2.32 hours.

PDKV Battery operated electric weeder

- Battery operated electric weeder was suitable for transverse in between the row crops of 45 cm. spacing as the design is compact.
- Average field capacity of electric weeder battery was observed .11 ha/h & cost of operation was Rs. 654/ha.
- It reduces the dependency from costly fissile fuels and promotes the use of green energy and it is usefull for small and marginal formers.
- As compare to bullock drown hoe the cost of saving was 27.33% and 73.4% over the manual drawn wheel hoe.

PDKV Multi-Commodity Seed Extractor for Vegetable.



- PDKV Multi-commodity seed extractor is suitable for extraction of tomato, cucumber & brinjal seeds.
- Capacity of the machine is 300 kg/h.
- The seed extraction efficiency of machine is 95 - 98%.
- This machine can be operated with 3 hp three phase electric motor
- Multi-commodity seed extractor is useful for seed growers.

PDKV UV-Assisted Treatment Device for post harvest decay control in Nagpur Mandarins

- Useful for reducing rotting losses of Nagpur Mandarins under ambient storage and cold storage.
- Reduces rotting by eco-friendly UVC treatment without using fungicides during waxing step.
- The machine is operated on 3 horse power motor.
- It has continuous type operation.
- Treatment capacity of machine is 2 tons/day.
- The clearance between fruit and UV source can be adjusted according to the size of the fruits.

- Maintenance cost of the machine is less and easy for handling.

PDKV solar biomass hybrid drying system

- The time required for drying of agricultural produce like Ginger, Onion and Sprouted Moth Bean sample in continuous type solar biomass drying system was found less as compared to Solar Tunnel Dryer and Open Sun Drying.
- Drying efficiency of biomass based air heating system in solar biomass hybrid dryer was 43.00 %
- In Continuous type solar biomass hybrid drying system, uniform and faster drying was achieved.
- The system was found economically feasible for drying of ginger, onion and sprouted moth bean and can be used for other Agricultural produce.

Year : 2023

PDKV developed battery electric vehicle sprayer

PDKV developed battery electric vehicle sprayer is recommended for spraying operation in various row crops like green gram, soybean, chickpea etc.

- Battery electric vehicle operated sprayer satisfactorily transverse in between 30, 45, 60 and more than 90 cm row spacing crops.
- It is suitable for spraying in the low heighted row crops.
- It reduces the dependency from costly fissile fuels and promotes the use of green energy.

Inventory - IV

- It satisfactorily sprays the liquid at bottom top and middle part of the crops.
- The field efficiency of the sprayer was 1.09 ha/ha whereas the cost of operation was Rs. 145/ha

PDKV developed biochar production process from agro-residue

PDKV developed continuous biochar reactor having a capacity of 30 kg/h is recommended for release to convert agro residues such as cotton stalk into high valued biochar

- Capacity: 30kg/h
- Biochar reactor converts cotton stalk into biochar
- Saves time, electrically operated and require less time than conventional method.
- Machine is efficient and yield is 35%.
- Produces 75% more yield than traditional method.
- Produces high valued biochar (fixed carbon 67% calorific value 5015kcal/kg and iodine value 330 mg/g)

PDKV Custard Apple Peel and Pulp Separation Machine

PDKV peel and pulp separation machine is recommended to release for separation of custard apple peel and pulp.

- Suitable for separation of custard peel and seeded pulp.
- Pulp separation efficiency of machine is 92.60 per cent.
- Capacity of machine is 80.15 kg/h.
- Machine can be operated on 0.5 hp single phase electric motor.
- This machine is useful for custard apple processor.

PDKV wood apple cutting machine

PDKV developed wood apple fruit cutting machine is recommended to release for cutting of wood apple.

- Machine size: 914 mm H X 470 mm W X 304 mm T
- Capacity: 200 kg/h
- Motor power: 1 Hp Single phase
- Ease of use and maintenance: Machine is easy for both to use and maintenance.

PDKV solar powered animal deterrent rotating light device for crop protection

PDKV developed solar powered animal deterrent device is recommended to protect the crop from wild animals.

- Solar powered animal deterrent device
- Protect the crop from wild animals.
- Wild animals get scared due to the light and noise that move in the night.

PDKV solar based insect trap device

PDKV developed multipurpose phero sticky light insect trap of six units per hectare is recommended for insect pest management as per integrated pest management technique.

- Solar based insect trap device
- Recommended to use six units per hectare
- Suitable for control of pest.

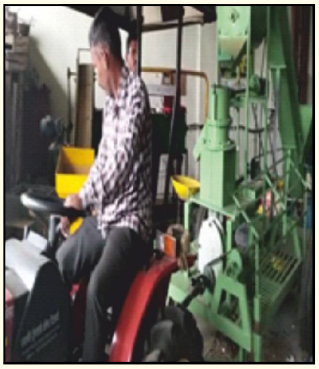
Year : 2024

Tractor operated turmeric harvester

- The developed turmeric harvester is suitable for digging turmeric rhizomes from raise beds.
- Digging efficiency of this equipment is 98.52 %.
- Saving in labor and time.
- Strong and durable construction.
- Ease in operation.

Inventory - IV

PDKV developed small tractor operated machine for production of pellets



- Agro residues such as soybean straw and cotton stalks can be used to produce pellets of 15 mm diameter
- The capacity of machine is 50 kg/h.
- Small tractor (18 -28 hp) is sufficient to operate feeding, mixing and pelleting mechanisms of pelleting machine.
- Bulk density and calorific value of pellet is improved compare to agro-residue.
- The pellets can be used in improved cook stove .

PDKV developed tractor drawn subsoiler attachment to rotavator

- Used to break the hard pan formed beneath the soil surface by the continuous use of the rotavator.
- The depth of operation of subsoiling can be varied from 23 to 45 cm.
- There is 58% saving over the cost of operation due to combined operation.
- Time saving is about 48% due to combined operation.

Year : 2025

PDKV Engine Operated Soybean Harvester

- Suitable for harvesting the two rows of soybean crop simultaneously
- Harvest the crop and lays it in the form of windrow which facilitates further collection of crop
- The average harvesting losses was observed to be 3.16 %.
- The effective field capacity and field efficiency were found to be 0.174 ha/h and 81.31 per cent, respectively.
- 35.38 % saving in cost of harvesting over manually harvesting.

PDKV Power Operated Linseed Thresher

- Threshing efficiency 99.41%.
- Threshing output capacity 25 kg/h.
- Cleaning efficiency 96.97 %.
- Overall grain losses 1.48 %
- The saving in cost of threshing 37 % over the traditional method of manual threshing.

PDKV Bullock Drawn No Till Paddy Planter

- The developed bullock drawn no till paddy planter is suitable for direct paddy planting.
- The paddy seed rates varied from 35.88 to 53.76 kg/ha.
- The field capacity 0.18 ha/hr and efficiency is 86.44% was found.
- Reduces cost, labour and drudgery by eliminating seedling uprooting, puddling and transplanting of paddy.

PDKV Energy Efficient Bio-Mass Based Distillation System for Essential Oil Extraction from Medicinal Plants

- Capacity of the system is 200 liters (20kg/batch).
- Used to extract essential oil from medicinal plants.
- Average extraction efficiency is 85%.
- Better quality essential oils extracted than conventional method.
- Biomass fuel consumption is less (6 kg/h) than conventional method.

PDKV Integrated Animal Deterrent Cum Solar Light Trap

- Operated completely on solar energy.
- Suitable for two acres of area.
- Simultaneous pest and wild animal control possible.
- Suitable in integrated pest control.
- Battery charging is through solar panel thus saves electricity.

Inventory - IV

PDKV manual drawn solar photovoltaic powered fertilizer broadcaster

- Width of vermi compost spreading was found 5.7 m.
- Actual field capacity and field efficiency of fertilizer broadcaster was found 0.62 ha/h and 71.0 % respectively.
- Broadcasting of vermi compost was found uniform at 300 rpm spinning disc.
- Saving in cost of operation 68% over the traditional manual broadcasting method.
- Device work continuously for 12 h.

PDKV Small Capacity Portable Grain Cleaner Cum Grader

- It is suitable for cleaning grading of soybean and other grains.
- The machine can easily move from one field to another field.
- Capacity: 100 kg/h.
- Power requirement: 0.5 hp electric motor.
- Cleaning efficiency: 88 to 90 %.
- Grading efficiency: 87 to 89 %.

PDKV Mini Besan Mill

- Suitable for milling of *besan* from chickpea dal.
- Capacity: 50 kg/h.
- Motor: 8 hp
- Recovery: 98 percent

PDKV mobile dryer for soybean drying

- PDKV tractor operated dryer is suitable for drying of soybean and other grains.
- Capacity: 2 tons/batch.
- Tractor requirement: 35 hp
- Temperature can be controlled.
- Fuel : 1.5 liters diesel per hour and 17 kg wood per hour.

3. CROP PRODUCTION TECHNOLOGIES / RECOMMENDATIONS

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.

3.1 NATURAL RESOURCE MANAGEMENT

3.1.1. Agronomy

Year : 2020

1. 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.
2. 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) through vermicompost (1.15 t/ha) or compost (1.87 t/ha) and 50 per cent RDN (15 kg/ha) through urea (and 75:30 kg/ha of P:K) to soybean at the time of sowing and supplementation of $ZnSO_4$ (@ 20 kg ha^{-1}) and $FeSO_4$ (@ 30 kg ha^{-1}) along with RDF (120:60:30 N:P:K kg/ha) to maize.
3. 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.
4. 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.
5. 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) is recommended.

Inventory - IV

6. For effective weed management in sole soybean, post emergence application of Propaquizafop @ 0.050 kg a.i. + Imazethapyr @ 0.075 kg a.i./ha at 21 DAS (2.0 L/ha ready mix commercial formulation in 500L water) or pre emergence application of Diclosulam 84% WDG @ 0.026 kg a.i./ ha (30 g/ha commercial formulation in 500L water) is recommended for higher seed yield and economic returns.

7. In drip irrigated cotton for increasing productivity, effective weed management and economic returns it is recommended to apply 125 per cent 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 kg a.i/ha at 30 DAS fb 1 HW 15 days after spraying and repeat spray of Paraquat @ 0.6 kg a.i./ha 60 DAS fb 1 HW 15 days after spraying, as per following schedule.

Splits of N & K (%)	Stage of crop	Fertigation Schedule						Herbicide Schedule			
		Quantity of N and K (kg/ha)			Quantity of fertilizers (kg/ha)			Herbicide	Stage of crop	Active ingredient (kg/ha)	Quantity of herbicide (kg/ha)
		N	K	P	Urea	MOP	SSP				
10 %	Basal	15.00	7.50	75Kg P_2O_5 At the time of sowing	32.55	12.45	470Kg SSP At the time of sowing	Paraquat 24% SL	30 DA	S0.300	1.25
20%	20DAS	30.00	15.00		65.10	24.90					
25%	40DAS	37.50	18.75	81.38	31.12			Paraquat 24%SL	60 DAS	0.600	2.50
25%	60DAS	37.50	18.75	81.38	31.12						
20%	80DAS	30.001	5.00	65.10	24.90						3.75
	Total	**150**	**757**	**532**	**5.511**	**24.4**	**9470**				

8. 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.

9. For getting higher yield and monetary returns from soybean, spraying of Nitrobenzene 20% @ 500 ppm (2.5ml/L of water) at flower initiation stage is recommended.

Year : 2021

10. In medium deep black zinc and sulphur deficient soils of Vidarbha region, for obtaining higher safflower yield, monetary returns and maintaining soil fertility, application of FYM 5 t ha^{-1} or *in situ* green gram residue incorporation into soil and nitrogen, phosphorus, potassium as per yield target equation +25 kg ha^{-1} zinc sulphate and 10 kg ha^{-1} sulphur is recommended. Targeted yield equation for safflower (JNKVV, Jabalpur) Nitrogen through fertilizer kg/ha = 9.11 X (Targeted yield q/ha) – 0.45 X (Available soil nitrogen kg/ha)Phosphorus through fertilizer kg/ha = 6.27 X (Targeted yield q/ha) – 2.19 X (Available soil phosphorus

kg/ha)Potassium through fertilizer kg/ha = 9.27 X (Targeted yield q/ha) – 0.38 X (Available soil Potassium kg/ha)

11. For obtaining higher productivity and economic returns in soybean-onion crop sequence, it is recommended to apply 75 % RDF (25:60:25 kg NPK ha^{-1}) + FYM 5 t ha^{-1} + Biofertilizers (*Rhizobium japonicum*+ PSB + *Tricoderma viridi*) to soybean and 100% RDF (100:50:50 kg NPK ha^{-1}) to rabi season onion crop is recommended.

12. Sowing of rice variety Avishkar is recommended under upland irrigated condition of Western Vidarbha with the fertilizer dose of 100:50:50 kg NPK ha^{-1} (RDF) along with FeSO4 @ 25 kg ha^{-1} and $MnSO_4$ @ 5 kg ha^{-1} at the time of sowing for obtaining iron and manganese enriched higher rice grain yield, grain protein, carbohydrate content and economic returns.

13. For obtaining higher sunflower equivalent yield and monetary returns in cropping system, it is recommended to undertake the sowing of Mung with 100% RDF (20:40:20 kg NPK ha^{-1}) or Soybean with 100% RDF (30:75:30 kg NPK ha^{-1}) in *Kharif* season and sunflower with 100% STCR based fertilizer dose in *Rabi* season. **STCR equation for Sunflower (Source: MPKV, Rahuri)** Nitrogen through fertilizer (Kg/ha) = 13.94 x Target yield (q/ha) – (0.61x available nitrogen in soil in Kg/ha.) Phosphorus through fertilizer (Kg/ha) = 7.18 x Target yield (q/ha) – (0.82 x available phosphorus in soil) Potassium through fertilizer (Kg/ha) = 3.53 x Target yield (q/ha) – (0.05 x available potassium in soil)

14. In organic farming system, soil application of 2.5 t/ha enriched PDKV compost mixed with *Rhizobium* and PSB @ 4.0 kg/ha along with two foliar sprays of liquid organic fertilizer (N:P:K) @ 30 ml / 10 lit. water at 20 and 40 DAS and for biological pest control spraying of botanical insecticide (Dashparni Ark or 5 % NSKE) and bio-pesticides (Beauveria and Metarhizium) is recommended for higher yield, monetary returns of green gram and sustainable soil fertility.

15. In organic farming system, soil application of 8 t/ha enriched PDKV compost mixed with *Rhizobium* and PSB @ 4.0 kg/ha along with three foliar sprays of liquid organic fertilizer (N:P:K) @ 30 ml / 10 lit water at 20, 40 and 60 DAS and for biological pest control spraying of botanical insecticide (Dashparni Ark or 5 % NSKE) and bio-pesticide (Beauveria and Metarhizium) is recommended for higher yield, monetary returns of wheat and sustainable soil fertility.

16. In medium deep black souls under rainfed conditions of Vidarbha, for achieving higher seed yield, monetary returns and rainwater use efficiency from the medium duration sole pigeonpea crop, sowing at a distance of 120 cm x 30 cm and nipping at 45 days after sowing is recommended.

17. In zinc and boron deficit soils for obtaining higher seed yield and economic returns of linseed crop along with recommended dose of fertilizer (60:30:00 Kg ha^{-1} NPK) foliar application of $ZnSO_4$ @ 0.5 % (5 g/liter of water) + Borax @ 0.3% (3 g/liter of water) at 45 DAS is recommended.

Inventory - IV

Year : 2022

18. In rainfed agro horticulture system for obtaining higher economic returns, intercropping of American improved cotton + soybean (1:1) in four years per plantation at spacing 6 x 6 m with pruning every year is recommended.

19. For obtaining higher productivity and monetary returns of Bt cotton under HDPS, it is recommended that sowing of improved American Rajat Bt variety at row to row spacing of 60 cm and plant to plant spacing of 15cm under rainfed condition with recommended dose of fertilizer 60:30:30 Kg N, P_2O_5 and K_2O per hectare.

20. In Eastern Vidarbha for getting significantly higher yield and more economic returns of coarse drilled paddy, drilling of paddy at 30 cm row to row spacing and seed rate of 80 kg ha^{-1} is recommended.

21. In linseed crop for maintaining optimum plant population, growth and higher productivity in irrigated condition, seed rate of 15 kg per hectare at 30 cm spacing is recommended. After harvesting of paddy crop, sowing of linseed with zero tillage method instead of broadcasting is recommended.

22. In Vidarbha region, under drip irrigated drilled rice-wheat crop sequence for increasing system productivity, economic returns and nutrient use efficiency, it is recommended to apply 100 per cent (100 kg N and 50 kg K_2O) in 12 splits at seven days interval through drip and full dose of P (50kg/ha.) as basal through soil application.

23. For direct seeded rice in eastern Vidarbha, application of Pre-em Pretilachlor 50 EC @ 0.75 kg a.i. ha^{-1} fb Bispyribac sodium @ 25 g a.i. ha^{-1} at 20 DAS fb, one hoeing at 40 DAS is recommended for integrated weed management and higher economic returns.

24. It is recommended to adopt 1.00 ha integrated farming system model under irrigated condition for small and marginal farmers of *Vidarbha* region of Maharashtra. The IFS model includes the components of various crops and cropping system (0.70 ha) + Fruits and vegetables (0.25 ha) + Goatary + Backyard poultry + PDKV Compost (0.03 ha) + Kitchen garden (0.02 ha) + useful plantation on field boundaries.

S.N	Components		
	Kharif	***Rabi***	**Summer**
A)	**Cropping systems**		
1.	*Deshi* Cotton (HDPS) + Pigeonpea (5:1) + Green gram in additive series (1:1)	—	Cowpea
2.	Soybean + Finger millets (1:1)	Chickpea	Cowpea
3.	Maize + Mesta (2:1) – Fenugreek + Coriander (Trap crop) (2:2)	Wheat	Cowpea
4.	Sorghum fodder	Berseem	Cowpea

5.	Sesame(0.10 ha), Niger (0.05 ha), Clusterbean (0.05 ha)	Linseed	Cowpea
B)	**Horticulture**		
6.	Custard apple + Drumstick	—	—
C)	**Livestock**		
7 .	Goat + Poultry + PDKV Compost		
D)	**Others**		
8 .	Kitchen garden		
9.	Boundary plantation of *Glyricidia*, *Karoanda and Hybrid Napier*		

25. For obtaining higher productivity, sustainable yield and economic returns, it is recommended to adopt the cropping system of Clusterbean+ Maize in *kharif* season and *ajwain* crop in *rabi* season.

26. Vermicompost prepared from soybean straw (75%) + cowdung slurry (25%) or sunhemp stalk (75%) + cowdung slurry (25%) is recommended for production of good quality, highest net recovery and nutrient content (N, P and K) of PDKV vermicompost.

27. For bio-fortification of vermicompost it is recommended to enrich with bio-inoculants consortia of *Azotobacter, Azospirillum* and PSB each @ 10 ml/5 kg bag (108 cfu/ml) of vermicompost.

28. Under organic cotton production, intercropping of blackgram in cotton (1:1) with soil application of Neem cake (250 Kg ha^{-1}) + seed treatment of recommended biofertilizers (Azotobacter & PSB) + foliar application of Pink-pigmented Facultative Methylotrophs (PPFMs) @ 1% at flowering and boll development stage and in-situ application (mulching) of blackgram residue after pod plucking is recommended for higher monetary returns, improving soil organic carbon, major nutrients availability and physical properties of soil under rainfed condition.

29. Microbial consortia @ 10 ml per 1 kg potting mixture is recommended for organically grown brinjal, tomato, and chilli crop seedling in nursery conditions for better growth and management of soil borne diseases.

30. For integrated pest management of leaf defoliator's infestation on soybean two spray of soybean oil based formulation of Metarhizium rileyi @250 ml/ha (containing 2.0 x 108 spores/ml) at 30 days and 45 days of crop stage is recommended.

31. Under paddy-wheat relay cropping for higher wheat yield and more economic return, it is recommended to use wheat 175 kg ha^{-1} seed rate and sown by broadcasting before 12 days of paddy harvest at sufficient moisture in the soil.

Year : 2023

32. After receipt of sufficient monsoon rains (75 to 100 mm) sowing of soybean in

Vidarbha during 25 June to 08 July is recommended for higher seed yield and economic returns. Later sowing from 09 July to 22nd July results in yield reduction to the extent of 36 %.

33. For obtaining higher green chilli yield and monetary returns under drip fertigation, it is recommended to apply RDF along with six foliar sprays of humic acid @ 1% (100 ml per 10 liter water) with first spray at flowering, 2nd at fruit setting, thereafter four sprays at 15 days after each picking.

34. For obtaining higher yield, improving quality of maize, higher monetary return as well as improvement in soil fertility and soil organic carbon the application of RDF along with biochar @ 5 t ha^{-1} is recommended.

35. In cotton based inter cropping system for obtaining higher seed cotton equivalent yield, monetary returns and to improve the soil fertility status, it is recommended the intercrops combination of paired row cotton (Two rows) + two rows of greengram (60-120-60 cm) under rainfed condition.

36. Sowing of soybean varieties PDKV Yellow Gold, Suvarn Soya and PDKV Amba by dibbling method with spacing of 45 x10 cm is recommended for getting higher yield and monetary returns.

37. For getting higher yield and monetary returns, sowing of soybean varieties PDKV Yellow gold, Suvarn soya and PDKV Amba with seedrate of 62.5 kg ha^{-1} (minimum 70% germination) is recommended.

Year : 2024

38. For higher yield of rainfed cotton the sowing should be done after the onset of monsoon with receipt of adequate rainfall (75 mm to 100 mm) in Vidarbha region, late sowing (10 to 15 July) will result in 24% reduction in yield.

39. Application of 275:125:125 kg NPK ha^{-1} {with three split application as Basal 40:65:65 (14% N + 50 % P + 50 % K), after 8-10 weeks 160:0:0 (57.5% N) and at final earthing up i.e. 16-18 weeks 75:60:60 (28.5% N + 50% P + 50 % K) kg NPK} is recommended for higher yield and economic return from Suru Sugarcane in Vidarbha region.

40. Transplanting of Paddy with application of recommended dose of fertilizer (100:50:50 Kg/ha, NPK) by Paddy transplanter at Spacing of 30 x 12 cm is recommended for higher grain yield and economic returns.

41. Three spraying of anacardic acid as a biostimulent @4mg/litre + Dimethyl Sulphoxide 0.5 ml/litre at 30,45 and 60 days after sowing is recommended for higher seed cotton yield and monetary returns in Bt cotton.

42. In cotton-based cropping system, for obtaining higher system productivity and monetary returns, it is recommended to grow chickpea or wheat (late sown variety) as a sequence crop after early Bt hybrids (140-150 days) in *kharif* with 100 percent RDF to *rabi* crops grown in sequence.

43. For obtaining higher grain, straw yield and economic returns of foxtail millet, sowing at 45 X 10 cm with application of 0:25:25 kg/ha NPK is recommended.

44. Sowing of midlate Bt cotton hybrid (BG-II) with 125 % recommended dose of N (150 Kg N) and K (75 Kg K) in four splits through fertigation (as given in table below with 75 Kg P as basal at sowing) and monopodia removal at 60 DAS and detopping at 75-80 DAS is recommended for higher seed cotton yield, water and nutrient use efficiency and monetary returns under drip irrigation.

Quantity of fertilizer to be applied in four splits	No. of splits	Stage of Crop
20 % N & K (30 Kg N+15 Kg K)	1st	Sowing
30 % N & K (45 Kg N+22.5 Kg K)	2nd	30 DAS
30 % N & K (45 Kg N+22.5 Kg K)	3rd	60 DAS
20 % N & K (30 Kg N+15 Kg K)	4th	90 DAS
Total Splits	**4**	

45. Sowing of 'Mid-late duration *Bt* cotton - summer groundnut' or 'Early duration *Bt* cotton - chickpea' cropping system is recommended for maximum yield and economic returns.

46. Intercropping of Chickpea + Mustard (6:1) or Chickpea + Mustard (5:2) is recommended for higher mustard equivalent yield and economic return.

47. In organic farming system following pulse based crop rotation and integrated nutrient management through organic sources to base crop of recommended dose of nutrients (50% RDNK through FYM + 25 % RDNK through Neem cake + 25% RDNK through Vermicompost top dressing) and P compensate through Phosphorus rich organic manure (PROM) is recommended for highest cotton equivalent yield, *in-situ* biomass yield, economics, system profitability, sustainable yield index, pest reduction and soil health. Spraying of botanicals (Dashparni ark @ 250 ml. in 10 lit. of water or 5% NSKE) and biopesticides (Beauveria and Metarhizium @ 40 ml in10 liter of water) and erection of pheromone traps (5 per hectare) for pest management is recommended.

First year	Second year	Third year	Fourth year	Fifth year
Blackgram – Chickpea	Cotton + Pigeonpea (3:1)	Pigeonpea + Blackgram (1:3)	Pigeonpea + Soybean (1:3)	Cotton + *in situ* green manuring of Sunhemp at 40 DAS (2:1)
OR				
Cotton	Pigeonpea + Soybean (1:3)	Cotton + *in situ* green manuring of Sunhemp at 40 DAS (2:1)	Sorghum + green manuring(1:2) - Chickpea	Cotton + Blackgram (2:1)

Inventory - IV

48. In organic farming system, for obtaining better quality, higher monetary returns and improving soil health through application of 50% RDNK through Vermicompost (6 t) + 50% RDNK through Neemcake (2 t/ha) + Biofertilizers or 50% RDNK through Vermicompost (6 t/ha) + 50% RDNK through FYM (17 t/ha) + Biofertilizers or 25% Vermicompost RDNK through (3 t/ha) + 25% RDNK through Jeevamrut (1000 litre @10% and remaining 2000 litre @ 20% at 15 days interval) + Biofertilizer + Green manure at 40 DAS and P compensate through Phosphorus rich organic manure (PROM) is recommended for turmeric. Spraying of botanicals (Dashparni ark @ 250 ml. in 10 lit. of water or 5% NSKE) and biopesticides (Beauveria and Metarhizium @ 40 ml in10 liter of water) for pest management is recommended.

49. Application of vermicompost 1.6 t/ha + seed treatment (Azotobacter 10ml/kg + PSB 10ml/kg + Trichoderma 6ml/kg) + Jeeva rut 500 L/ha (at 10 ,20 and 30 DAS) or application of vermicompost 1.6 t/ha + seed treatment (Azotobacter 10ml/kg + PSB 10ml/kg + Trichoderma 6ml/kg) + Cowdung slurry 700 L/ha (at 10 , 20 and 30 DAS) to spinach is recommended for getting higher yield, quality and monetary returns.

50. In organic farming system intercropping of cotton + blackgram sown in 2:1 proportion at 60 cm spacing (mulching of black gram after plucking of pods) + with application of vermicompost @ 2.5 t ha^{-1} before sowing + Jeevamrut 10% at 50 DAS and for pest management use of trap crop along with Trichocard @5 cards/ha 2 times and spraying with 5 % NSKE 250 ml/ 10 liter or Neem oil 5 ml/ liter of water, bio pesticide *Verticillium lecanii* @ 40ml/10 liter of water and collection and destruction of rosette flower is recommended for getting higher cotton equivalent yield and economic returns.

Yea : 2025

51. For higher seed cotton yield and monetary returns under rainfed condition, sowing of cotton on broad bed and furrow and single spray of Salicylic Acid @ 100 ppm during long dry spell of rainfall is recommended.

52. For effective weed management, higher pod yield and net return of kharif groundnut pre-emergence application of diclosulam 84% WDG, 26 g a.i./ha (formulation-30 g/ha) fb propaquizafop 2.5% + imazethapyr 3.75%, 125 g a.i./ha (formulation-2.0 lit/ha) 25 DAS or diclosulam 26 g a.i./ha (formulation-30 g/ha) as pre-emergence fb quizalofop ethyl 7.5% + imazethapyr 15%, 98.43 g a.i./ha (formulation-437.5 ml/ha) 25 DAS each through 500 litre of water are recommended.

53. For higher seed yield and economic benefits in Vidarbha, sowing of rainfed chickpea is recommended from 15th Oct. to 04th Nov (42-44 MW). Delayed sowing in 05th-11th Nov (45 MW) results in 7% yield reduction, while 12th-18th Nov (46 MW) leads to 15% yield reduction.

54. For higher yield and net monetary returns, sowing of linseed on Broad Bed Furrow during 12-25 November (46th to 47th Meteorological Week) is recommended in Eastern Vidarbha.

55. In Eastern Vidarbha Zone for higher yield and monetary returns from rabi crops under zero cultivation sowing of chickpea crop is recommended after harvesting of *kharif* early varieties of rice.

56. For higher yield and monetary returns from Maize + Pigeonpea intercropping system, sowing of maize and pigeonpea in 6:1 intercropping system alongwith application of 180:90:90 NPK kg ha^{-1} is recommended.

57. For offseason soybean seed production only (upto 30% yield reduction compared to kharif season) sowing of soybean during 26th November to 2nd December (48th Met Week) is recommended.

3.1.2. Soil Science and Agricultural Chemistry

Year : 2020

1. 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.

Year : 2021

2. In sulphur deficient soils for obtaining higher seed yield of chickpea, quality of seed, higher monetary returns and for improving soil fertility, soil application of S @ 30 kg ha^{-1} through Bentonite sulphur (35 kg ha^{-1}) or through Gypsum (130 kg ha^{-1}) along with recommended dose of fertilizer (25:50:30 kg ha^{-1} N, P_2O_5 & K_2O) is recommended.

3. In view of the higher use efficiency, release and fixation pattern of Phosphorus, it is recommended to use 30:60:30 kg N, P_2O_5 and K_2O ha^{-1} for getting higher soybean yield and monetary returns in Vertisols of Vidarbha.

4. Alkaline (0.5 N) extraction method is recommended for higher recovery, nutrient composition and functional group of humic substances extracted from vermicompost.

5. "PDKV Enriched Compost" method for rapid preparation of wheat straw compost with addition of glyricidia leaves, rock phosphate, elemental sulphur along with PDKV Decomposer is recommended.

Year : 2022

6 Intercropping of Bt. cotton + greengram / blackgram (1:1) along with application of 75% RDF through chemical fertilizers (65:35:35 N, P, K kg ha^{-1}) + 25% compensation through PDKV enriched compost and burying of crop residues of greengram and blackgram after harvest is recommended for productivity of cotton with higher

monetary returns and improvement in fertility status of Vertisols under rainfed condition.

7. Application of 100% N through 4 tones Phosphocompost + remaining dose (10 kg P ha^{-1} and 4 kg K ha^{-1}) through chemical fertilizers to Soybean and 100 % P through 2 tones Phosphocompost + remaining dose (45 kg N ha^{-1} and 20 kg K ha^{-1}) through chemical fertilizers to Cotton under conservation tillage is recommended for obtaining higher productivity of Soybean and Cotton, monetary returns and improvement in soil health in Soybean-Cotton rotation in Vertisols under rainfed system.

8. The application of PDKV enriched compost 3.0 t ha^{-1} at the time of planting and 0.5 % spray of humic acid 60 & 90 days after planting is recommended for obtaining higher dry root yield, improved quality, higher monetary return of safed musali and enhanced soil fertility.

9. In zinc deficient soils, for obtaining higher yield, monetary returns and improving soil fertility under cotton - soybean rotation, soil application of Zn @ 7.5 kg ha^{-1} through Zinc sulphate (35 kg ha^{-1}) in alternate year along with recommended dose of fertilizer is recommended.

Year : 2023

10. Melghat hilly region eroded reddish-gray soils of Amravati district are classified as Medium deep (Inceptisol), Shallow (Entisol) and Deep soils (Vertisol) and as per land evaluation and soil site suitaibility, medium deep and deep soils are suitable for cultivation of sorghum, soybean, pigeonpea, chickpea and wheat crops, however shallow soils are suitable for silvipasture and agroforestry. Thus, for food and feed security of tribals of Chikhaldra and Dharni Tahasil cultivation sorghum/soybean and pigeon pea as intercropping kharif and on the basis of availability of irrigation, rabi chickpea or wheat crops are recommended.

11. For obtaining higher productivity, quality and monetary returns in Ambiabahar of Nagpur Mandarin ,application of 300 g K per tree along with RDF at the time of bahar treatment and 300 g K per tree after 60 days and foliar spray of KNO_3 @ 1.5% after 90 days of bahar treatment is recommended in medium deep black soils of Vidarbha region.

12. For balance nutrition and higher yield of wheat with maintaining soil fertility, in-situ burying of sunhemp 30 DAS along with addition of Ghan jivamrut @ 5 t ha^{-1} before sowing and seed treatment of Azotobactor + PSB and basal dose of 50 % N and P205 (50 kg N and 25 kg P_2O_5 ha^{-1}) and top dressing with two foliar spray of jivamrut @ 500 lit ha^{-1} (1:10 ratio) at tillering and jointing stage is recommended.

13. For obtaining 15q targeted seed yield of rainfed Bt Cotton, higher economic returns and improved soil fertility, an application of 5 ton FYM along with chemical fertilizers as per fertilizer prescription equation is recommended in medium deep black soils of Vidarbha region

Targetted yield equation

Fertilizer Nitrogen kG ha^{-1}

(10.71 x Targetted yield q ha^{-1}) - (0.42 x Soil nitrogen kg ha^{-1}) - (2.38 x FYM)

Fertilizer Phosphorus kg ha^{-1}

(5.13 x Targetted yield q ha^{-1}) - (2.55 x Soil Phosphorus kg ha^{-1}) - (0.65 x FYM)

Fertilizer Potassium kg ha^{-1}

(5.51 x Targetted yield q ha^{-1}) - (0.13 x Soil Phosphorus kg ha^{-1}) - (0.89 x FYM)

14. For obtaining higher yield and monetary returns of rainfed bt-cotton and improvement in soil fertility, application of fertilizer dose of 90:45:45 (N, P_2O_5 and K_2O) kg ha^{-1} is recommended.

15. It is recommended to apply 125 % RDF i.e. 125:62.5:62.5 kg NPK per hectare through fertigation scheduled as 15 % NPK (1-10 DAT), 50 % NPK (11-35 DAT) and 35 % NPK (36-60 DAT) in12 splits at 5 days interval as mentioned below for obtaining maximum growth, yield, better quality of broccoli with higher net monetary returns.

Split No	Days after planting	Water soluble fertilizers to be applied through drip irrigation (Kg/ha)		
		N	P	K
1	5	9.37	4.68	4.68
2	10	9.37	4.68	4.68
3	15	12.5	6.25	6.25
4	20	12.5	6.25	6.25
5	25	12.5	6.25	6.25
6	30	12.5	6.25	6.25
7	35	12.5	6.25	6.25
8	40	8.75	4.37	4.37
9	45	8.75	4.37	4.37
10	50	8.75	4.37	4.37
11	55	8.75	4.37	4.37
12	60	8.75	4.37	4.37
	Total	**125**	**62.5**	**62.5**

16. Under fertigation in maize for higher grain yield, effective weed management and net returns it is recommended to apply 125 per cent recommended dose of nitrogen and potassium (150 kg N & 75 kg K_2O) in five splits through drip and phosphorous (75 kg P_2O_5) as basal through soil application along with pre-emergence application of atrazine 50% WP @ 0.50 kg/ha (1 kg/ha commercial product) fb post emergence application of topramezone 33.6% SC @ 0.0252 kg/ha (75 ml/ha commercial product) at 25 DAS as per following schedule.

Inventory - IV

NK splits (%)	Stage of crop	Fertigation schedule						Herbicide schedule			
		NK dose (kg/ha)			Fertilizer (kg/ha)			Herbicide	Crop stage ha)	a.i. (kg/ (kg/ha)	Formul-ation
		N	K_2O	P_2O_5	Urea	MOP	SSP				
10%	Basal	15.0	7.50	Basal	32.5	12.5	Basal	Atrazine	Next	0.50	1.00
20%	20 DAS	30.0	15.00	75 kg/ha			468 kg/ha	50% WP	day of sowing	65.0	25.0
25%	40 DAS	37.5	18.75		81.2	31.2		Topramezone 33.6% SC	25 DAS	0.0252	75 ml
25%	60 DAS	37.5	18.75		81.2	31.2					
20%	80 DAS	30.0	15.00		65.0	25.0					
	Total	**150**	**75**	**75**	**325**	**125**	**468**				

Year : 2024

17. Under long term (37 years) integrated nutrient management, for maintaining antecedent SOC at 6.5 g kg^{-1} and available nitrogen 253 kg ha^{-1}, it is recommended to incorporate 50% N (30 kg ha^{-1}) through Gliricidia green leaf manure (4 tons/ha) or FYM (6 tons/ha) alongwith remaining recommended 50% N (30 kg ha^{-1}), 100% P (30 kg ha^{-1}) and K (30 kg ha^{-1}) through chemical fertilizers to cotton + greengram (1:1) intercropping system for improvement in soil quality with sustainable system productivity and SOC storage to ensure around 77 kg ha^{-1} increase in system productivity for each 1 mg ha^{-1} increase in SOC stock in semi-arid Vertisols.

18. For obtaining good quality, higher yield and monetary returns of garlic bulbs in medium deep soil, application of 15 t FYM ha^{-1} before planting and total fertilizer dose of 80: 40: 40: 32 NPKS ha^{-1} should be applied, out of which 24: 16: 12: 16 kg ha^{-1} NPKS as basal dose and remaining nutrients in 7 splits through drip fertigations @ 8 : 3.4 : 4.0 : 2.3 kg ha^{-1} NPKS through water soluble fertilizers after 15 days of planting at 12 days interval is recommended.

19. In global warming era, in order to mitigate the GHG emission from Integrated Farming System based agriculture sector, it is recommended that, in the 1.00 ha of irrigated IFS model, all the crop residues should be recycled *in situ* and the system should include suitable horticultural fruit crop on at least 0.25 ha and plantation of suitable forest multipurpose tree species (MPTS) on border of farm for adequate negative balance i.e. carbon credit of GHG emission.

20. The application of 100% RDF along with PDKV enriched NPS compost @ 2.5 tonnes ha^{-1} and 4 foliar sprays of 1% humic acids at flowering, fruit setting, after first and second picking is recommended for higher yield and quality of brinjal with improvement in soil fertility and higher economic returns.

Year : 2025

21. Application of 300 kg natural zeolite ha^{-1} along with recommended dose of fertilizers (90: 45: 45 N, P and K kg ha^{-1}) is recommended for obtaining higher yield, monetary returns of Bt cotton and improving soil fertility in salt affected soils of Purna valley.

22. In medium deep black soil, for obtaining higher yield of sunflower, gross monetary return, oil seed quality and for improving the fertility status of soil, addition of biomass briquette ash @ 2.25 t ha^{-1} as a source of potassium along with recommended dose of 80:60 N P kg ha^{-1} is recommended.

23. To improve the nutrient balance and to achieve optimal fruit yield in banana fruit crop in Vidarbha, it is recommended that, new DRIS indices preferably for soil should be used fordiagnosing sufficiency and deficiency of nutrients. Accordingly, the blanket RDF of primary nutrients should be modified on the basis of new DRIS norms as: in very low/ deficient category- 50% more, low-25% more, optimum- no change, high- 25% less and very high/excess- 50% less. The secondary and micro-nutrients with most negative DRIS index value only should be applied as per RDF. However, it is also recommended to use either soil fertility or leaf nutrient or both new DRIS norms given in following tables as per convenient to farmers.

Table 1. New DRIS norms for soil fertility status of banana orchards

Soil parameter/Available nutrient (unit)	Very low (Less than)	Low	Optimum (More than)	High	Very high
pH	7.12	7.13 - 7.47	7.48 - 8.17	8.18 - 8.52	8.53
EC (dSm^{-1})	0.06	0.07-0.11	0.12- 0.43	0.44 - 0.59	0.60
Organic Carbon (g kg^{-1})	3.34	3.35 - 4.97	4.98 - 8.24	8.25 - 9.88	9.89
$CaCO_3$ (%)	2.02	2.03-4.03	4.04-14.55	14.56-19.81	19.82
N (kg ha^{-1})	150.00	151 - 194	195 - 282	283 - 327	328
P_2O_5 (kg ha^{-1})	7.00	8 - 13	14 - 48	49 - 65	66
K_2O (kg ha^{-1})	268.00	269 - 453	454 - 824	825 - 1009	1010
Ca (c mol(p+) kg^{-1})	12.45	12.46-21.14	21.15-38.52	38.53-47.2	47.21
Mg (c mol(p+) kg^{-1})	2.05	2.06 - 4.1	4.11 - 24.58	24.59-34.82	34.83
S (mg kg^{-1})	4.64	4.65 - 9.28	9.29 - 32.9	32.91-44.71	44.72
Fe (ppm)	0.74	0.75 - 1.47	1.48 - 14.15	14.16-20.48	20.49
Mn (ppm)	1.63	1.64 - 3.25	3.26 - 17.59	17.6-24.76	24.77
Cu (ppm)	0.60	0.61 - 1.2	1.21 - 4.87	4.88 - 6.71	6.72
Zn (ppm)	0.13	0.14 - 0.26	0.27 - 0.98	0.99 - 1.34	1.35
Yield (ton ha^{-1})	74.00	75 - 86	87 - 109	110 - 120	120

Inventory - IV

Table 2. New DRIS norms for leaf nutrient status of banana orchards.

Leaf nutrient (unit)	Deficient (Less than)	Low	Optimum	High	Excess (More than)
N (%)	1.69	1.7 - 2.37	2.38 - 3.74	3.75 - 4.42	4.43
P (%)	0.11	0.12 - 0.22	0.23 - 0.43	0.44 - 0.54	0.55
K (%)	2.45	2.46 - 3.56	3.57 - 5.76	5.77 - 6.86	6.87
Ca (%)	0.34	0.35 - 0.68	0.69 - 2.49	2.5 - 3.39	3.40
Mg (%)	0.41	0.42 - 0.61	0.62 – 1.00	1.01 - 1.20	1.21
S (%)	0.15	0.16 - 0.31	0.32 - 0.64	0.65 - 0.80	0.81
Fe (ppm)	98.00	99 - 159	160 - 282	283 - 343	344
Mn (ppm)	273.00	274 - 547	548 - 1796	1797-2421	2422
Cu (ppm)	2.00	2.01 - 3.99	4 - 13.19	13.2 - 17.79	17.80
Zn (ppm)	5.79	5.8 - 19.79	19.8 - 47.78	47.79-61.77	61.78
Yield (ton ha^{-1})	74.00	75 - 86	87 - 109	110 - 120	121

24. For higher seed cotton yield and monetary returns from Bt-cotton and improvement in soil fertility, application of 75 % (90:45:45 kg N, P_2O_5 and K2O ha^{-1}) recommended dose of fertilizers through Urea and Muriate of potash (MOP) in five splits through fertigation (with P as basal at sowing) is recommended under drip irrigation.

Fertilizer split	Percent split	Time
1st	10 % N & K (9 kg N + 4.5 kg K)	At sowing
2nd	20 % N & K (18 kg N + 9 kg K)	20 DAS
3rd	25 % N & K (22.5 kg N + 11.25 kg K)	40 DAS
4th	25 % N & K (22.5 kg N + 11.25 kg K)	60 DAS
5th	20 % N & K (18 kg N + 9 kg K)	80 DAS

25. For obtaining higher yield under rainfed Bt-cotton, it is recommended to apply foliar sprays of PDKV Micro- Grade XI @ 1 % at 45 and 60 days after sowing along with 100% (90:45:45 N, P_2O_5 and K_2O kg ha^{-1}) recommended dose of fertilizers

26. For obtaining higher yield and economic return of summer groundnut and for improvement in soil fertility status, soil application of recommended dose of fertilizer (25: 50:30 kg ha^{-1} N, P_2O_5 and K_2O) with zinc EDTA + Fe EDDHA @ 1.5 kg ha^{-1} eachat the time of sowing along with foliar application of Zn EDTA @ 0.5 % + Fe EDDHA @ 1.0 % at 35 DAS and 65 DAS is recommended.

27. In zinc deficient soil for obtaining higher wheat yield, monetary return and for improving soil fertility status, soil application of zinc sulphate @ 15 kg ha^{1} or zinc EDTA @ 1.5 kg ha^{-1} along with recommended dose of fertilizer (80:40:40 kg ha^{1} N, P_2O_5 and K_2O) is recommended.

28. Application of 50 % through FYM (6t ha^{-1}) or vermicompost (1.5 t ha^{-1}) + 50 % N through Gliricidia (4 t ha^{-1}) + Phospho-compost-phosphate rich organic manure (190 kg ha^{-1}) is recommended for rainfed organic cotton for sustainable productivity in vertisols.

3.2. HORTICULTURE

Year : 2020

Fruit Crops

1. 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 is recommended.
2. 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.
3. Nagpur mandarin fruits coated with GSNp Tulsi (0.06 mg GSNp + 15 g guar gum per liter of water) is recommended to extend the storability of fruits for 60 days in mrig bahar and 45 days in ambia bahar under cold storage conditions (90-95 % humidity and 4-5^{0}C temperature).
4. 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^{0}C in deep freezer.

Vegetable Crops

5. 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 per hectare.
6. For seed production of Kasuri methi, sowing in second fortnight of October with application of 40:50:25 kg NPK per hectare is recommended for the higher seed yield and monetary returns.

Year : 2021

Vegetable Crops

7. Under Vidarbha conditions, for getting maximum yield and higher monetary returns from Sweet corn cultivation, application of 5 ton Farm Yard Manure (FYM) along with 200 kg nitrogen, 80 kg phosphorus and 80 kg potassium per hectare is recommended.
8. For Preparation of nutritive and delicious cookies of aerial yam, per 1000 g of composite flour, addition of 60 % aerial yam flour in wheat flour+ 600 g. sugar + 500g Vanaspati ghee + 10 g. sodium bicarbonate is recommended.

Inventory - IV

Medicinal & Aromatic Plants

9. Green gram - Ashwagandha Crop sequence is recommended for getting higher dry root yield and economic returns with quality roots of Ashwagandha.

10. Intercropping of Safed musli + Pigeon pea with 3:1 or Safed musli + Maize 3:1 row proportion is recommended for higher dry root yield and economic returns, maximum saponin content and minimum Percent incidence of root rot.

11. Kawachbeej – Cluster bean sequence cropping is recommended for getting higher economic yield and L-DOPA content in Kawachbeej.

Year : 2022

Fruit Crops

12. For exportable fruit production (fruit length, girth and weight) of Grand Naine banana, retention of 9 hands per bunch is recommended.

13. For successful propagation of Dragon fruit, stem cuttings treated with IBA 2000 ppm concentration for five minutes is recommended

14. Foliar sprays of NAA (10 ppm) or GA 10 ppm or 2-4,D (15 ppm) along with N-ATCA (10 ppm) + Brassinolide (4ppm) + Folic acid 100 ppm, in the month of July and second spray in August is recommended for higher yield and more economic returns from mandarin in *Ambia bahar*.

15. For preparation of red wine form Nagpur Mandarin which has disease resistant, good digestibility and antioxidant properties, the proportion of Nagpur Mandarin juice, coloured grape juice and honey 4:1:1.025 is recommended.

Vegetable Crops

16. Application of vermicompost @ 9.2 ton OR neem cake @ 2.5 ton along with azatobacter @ 5 kg + PSB @ 5 kg per hectare is recommended at the time of planting for getting better quality higher yield and economic returns of organic beetroot.

17. For obtaining higher yield and monetary returns of watermelon, transplanting during first fortnight of January at 2.0 X 0.45 m spacing is recommended.

18. For obtaining higher yield and monetary return of capsicum under shade net house conditions, foliar application of 1% potassium nitrate (KNO_3) OR 60 ppm NAA at 30,45,60 and 75 days after transplanting along with RDF(190:115:150 kg NPK ha^{-1}) is recommended.

Year : 2023

Fruit Crops

19. For obtaining more monetary returns, higher yield and quality fruits of banana, fertilizer dose of 200:40:200 g NPK/plant through soluble fertilizers in 16 equal split (12.50: 2.50: 12.50 g NPK/plant) through drip irrigation at fifteen day intervals is recommended for Vidarbha region.

20. For light to medium soils of Vidarbha region, custard apple plant spacing 4 m x 2.5 m (1000 plants/ha) with the medium pruning in second fortnight of May and 40 to 60 fruits retention per plant is recommended for obtaining the quality fruit yield and higher economic returns.

21. For early and higher seed germination with better seedling growth of charoli, pre-sowing seed treatment of physical scarification (seed coat slightly cracking) followed by seed soaking in GA_3 300 ppm for 24 hrs is recommended.

22. For production of quality citrus grafts and obtaining higher economic returns, covering of root stock by used fertilizer bag strip or black polyethylene tape instead of traditional method of removal of unwanted side shoots on root stock is recommended.

Vegetable crops

23. For obtaining better growth, yield, quality and higher monetary returns from hybrid watermelon grown on 30 micron plastic mulch, it is recommended to apply 80 % of irrigation water requirement along with 250:125:125 kg NPK/ha in 20 equal splits i.e. 12.5:6.25:6.25 kg NPK/ha per split at four days interval through drip fertigation.

24. It is recommended to use drip fertigation with fertilizer level of 125 % RDF (i.e. 188:94:94 N:P_2O_5:K_2O kg ha^{-1}) to be applied in 15 splits at an interval of 10 days (half dose in first 6 equal splits and remaining half dose in 9 equal splits) and 80 % replenishment of ETc along with silver polyethylene mulch, to obtain higher yield of brinjal and benefit cost ratio.

25. For obtaining higher fruit yield, good quality and higher monetary return of bottle gourd application of 150:75:75 N, P_2O_5 and K_2O through fertigation (in ten equal split doses at ten days interval) along with two foliar spray of $FeSO_4$ + $ZnSO_4$ @ 0.25 % each at flower initiation and fruit set is recommended.

26. In Vidarbha region in fruit crop based intercropping system for getting more productivity from unit area it is recommended to grow turmeric variety PDKV Waigaon as intercrop in aonla orchards.

27. For obtaining better growth, yield, quality and higher monetary returns from hybrid green chilli grown on 30 micron plastic mulching rabi season, it is recommended to use 17 GSM non–woven white colour crop covers upto 45 days after transplanting.

28. In Vidarbha region to take production in kharif season by planting set onion it is recommended to sow seed on raised bed at the rate of 4 gm/m^2 in first week of February and these ready set to plant in second week of July at spacing of 15 X 15 cm.

Floriculture

29. For better germination and commercial propagation of Adenium, seeds soaking in GA3 200 ppm concentration for 12 hrs and sowing in Sand + FYM (1:1) proportion is recommended

Inventory - IV

30. For commercial propagation and better germination of Royal Palm seeds soaking in GA3 1500 ppm concentration for 24 hours before sowing is recommended.

31. For early rooting, better vegetative growth and commercial propagation of Semi-Hardwood cuttings of Ixora, treatment with IBA 2000 ppm concentration for 30 minutes is recommended.

Medicinal Plants

32. Sowing of Shatavari on Ridges and furrow at 60 X 30 cm spacing with application of 5 t/ha FYM is recommended for dry root yield and net monetary return.

Year : 2024

Fruit Science

33. For preparation of jamun bar, cooking of fruit pulp mixed with stevia powder till achieved 30^0B TSS is recommended.

34. For preparation of mandarin jam, in 1 Kg mandarin juicy vesicles addition of 650 g of sugar is recommended.

35. Foliar sprays of 15 ppm GA3 (Gibberellic acid) along with 15 ppm CPPU (*Forchlor fenuron*) or 2 ppm brassinolide, at initiation of flowering and pea size fruit stage is recommended for reduction of fruit drop, higher yield and more economic returns from mandarin in *mrig bahar*.

Vegetable Science

36. For obtaining higher yield with better monitory return of turmeric, it is recommended to use soybean straw as mulch and apply 80% of RDF i.e 160:80:80 NPK, Kg/ha of soluble fertilizer through drip irrigation in 30 equal split at 5 days interval.

37. For obtaining higher onion seed yield, quality and monitory return, use of 30 micron thick, silver colour polyethylene mulch or use of organic mulch (soybean straw) along with 90% replenishment of irrigation water is recommended.

38. For obtaining higher marketable bulb yield and quality of onion, it is recommended to adopt drip system of irrigation and fertigation dose of 80:40:40:24 kg NPKS/ha along with 11 splits at 6 days interval should be applied as per below table.

Split No	Days after planting	Water soluble fertilizers to be applied through drip irrigation (Kg/ha)			
		N	P	K	S
1	15	8.0	4.0	4.0	2.40
2	21	12.0	4.8	5.2	2.88
3	27	12.0	4.8	5.2	2.88
4	33	12.0	4.8	5.2	2.88
5	39	12.0	4.8	5.2	2.88

6	45	8.0	4.4	3.2	2.88
7	51	5.6	4.4	3.2	2.40
8	57	5.6	4.0	3.2	2.40
9	63	4.8	4.0	3.2	2.40
10	69	0.0	0.0	1.2	0.00
11	75	0.0	0.0	1.2	0.00
	Total	**80.0**	**40.0**	**40.0**	**24.00**

Floriculture

39. Application of recommended dose of fertilizer (300:200:200 N,P,K Kg per ha), 50% (150:100:100 N:P:K Kg/ha) as a basal dose and 50% (150:100:100 N:P:K Kg/ha) through water soluble fertilizer in eight equal splits from 20 DAP at 10 days interval is recommended for obtaining better quality flower spikes and more number of corms and cornels in Gladiolus.

40. For obtaining higher flower yield and monetary returns, planting of aster flower crop at 30 x 20 cm spacing and two spray of 1.0 per cent calcium nitrate at 30 and 50 days after transplanting is recommended for Vidarbha region.

41. For commercial propagation of Bougainvillea, dipping of hardwood cuttings in IBA 2000 ppm concentration solution for five minutes is recommended.

42. For preparation of better-quality wine from rose (*Rosa Centifolia*) petal, inoculation of the must with Saccharomyces cerevisiae *var*. ellipsoideus @15 ml. per liter and maintaining 24° Brix total soluble solids is recommended.

Year : 2025

Fruit Science

43. Spraying of NAA 300 ppm at fruit setting stage for abdonment of ambia bahar and getting higher yield and more economic return in subsequent mrig bahar of mandarin is recommended for Vidarbha region.

44. In Vidarbha region, for reduction of *waibar* disorder in Nagpur mandarin, it is recommended to apply following schedule per plant. 1) At the time of stress release (January) 300g N+150g P+150g K 1000 ppm + 5 Kg. $acre^{-1}$ Arka microbial consortium (Soil application). 2) After 1 month of 1st application (February) 300 g N + 150 g P + 150 g K, 3). After 1 month of 2nd application (March) 300 g N + Foliar spray of 0.2 % micronutrients (Cu, Fe, Mn, Zn). 4) In the month of April – May spray of NAA 10 ppm. 5) In the month of June – July spray of Nimbodi Ark 5% + 2,4-D 10 ppm. 6) In the month of August – September, spray of Propergite 57% EC 0.2% + 1% Potassium nitrate (KNO_3). 7) Seven doses of Jivamrut 10 L $plant^{-1}$ applied at 15 days interval (Jan-April).

Inventory - IV

Vegetable Science

45. For getting higher yield and monetary returns from organic seed production of fenugreek, application of vermicompost @ 3.0 t ha^{-1} OR FYM @ 6.0 t ha^{-1} OR enriched compost @ 3.5 t ha^{-1} + seed treatment of Rhizobium & PSB (@ 10ml/kg seed each) is recommended.

46. For getting higher yield and monetary returns from organic seed production of fenugreek, application of vermicompost @ 3.0 t ha^{-1} OR FYM @ 6.0 t ha^{-1} OR enriched compost @ 3.5 t ha^{-1} + seed treatment of Rhizobium & PSB (@ 10ml/kg seed each) is recommended.

47. For obtaining higher yield and monetary returns of turmeric, it is recommended to use finger rhizomes as planting material with soaking in GA3 100 ppm for 30 minutes and spraying of Cocycel 250 ppm at 60 and 90 days after planting.

48. For preparation of higher quality beetroot powder pre-treatment steam blanching of 3 mm thickness beetroot slices for 3 minutes and cabinet tray drying at 50 ^{0}C temperature for 12 hrs. is recommended.

Floriculture

49. Application of 250:100:100 kg NPK per hectare per year in four equal splits, first splits, first split at the time of clipping and remaining at three months interval after clipping is recommended for better vegetative growth, flower yield and bulb production of spider lily.

    At the time of clipping – First fortnight of June: 62.50:25:25 Kg,NPK/ha.

    At 90, 180 and 270 days after clipping: 62.50:25:25 Kg, NPK/ha.

50. Dipping of hardwood cuttings of Croton in IBA-400 ppm concentration solution for five minutes is recommended for commercial propagation.

Agroforestry

Year : 2020

1. For higher biomass production and higher monetary returns from bamboo plantation cultivation of Bamboosa balcooa (Bhima), Dendrocalmus stocksii (Manga) and Bamboosa bambose (Katang) species are recommended.

Year : 2022

2. For improving the raw material supply to wood based industries, for higher wood volume production (156.70 m3 ha^{-1}), higher monetary return (Rs. 1229703 ha^{-1}), higher carbon sequestration (39.17 t ha^{-1}) and for higher B/C ratio (4.93) plantation of progeny of Maharukh (*Ailanthus excelsa)* ACN/MHK/1 is recommended under agroforestry.

3. When *Bamboosa balcooa* (Bhima) is planted at 8 X 4 Mt spacings under agroforestry system and Cowpea is grown as intercrop in kharif season then for higher bamboo biomass production (77.80 t ha^{-1}), higher net monetary returns (Rs

300151/- ha^{-1}) and higher benefit cost ratio (3.50), application of 125 per cent more dose of fertilizers than recommended dose (25:50:0) to cowpea is recommended .

Year : 2024

4. Under rainfed cultivation protective irrigation of Bhaluka bamboo (*Bambusa balcooa*) and Manga Bamboo (*Dendrocalamus stockssi*) for higher bamboo biomass, number of bamboo pole production and monetary returns, it is recommended to apply the fertilizer dose 150:40:125 NPK gm per year clump (plant) during establishment phase (First to Fourth year).

Year : 2025

5. For preparation of energy pellets of higher calorific value from bamboo it is recommended to mix 10 % Moha cake + Sal cake as binder in equal proportion

3.3. PLANT PROTECTION

Year : 2020

Plant Pathology

1. 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.
2. 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.

Entomology

3. 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.
4. For getting higher paddy yield and effective management of stem borer application Carbofuran 3 % CG @ 25 kg/ha (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.
5. For effective management of paddy stem borer six innundative releases of Trichogramma japonicum @ 1,60,000 eggs/ha (8 cards) starting from 30 days after transplanting (DAT) with subsequent releases at an interval of one week is recommended.

Inventory - IV

Year : 2021

Entomology

6. For effective management of hoppers on paddy, getting higher yield and monetary returns, leave alleyways of 30 cm after every 10 rows (or 2 m) during line transplanting (20 X 15 cm) with rope. Further, at incidence of hoppers noticed spraying of Flonicamid 50 % WG @ 3 g followed by Fipronil 5% SC @ 20 ml per 10 liter water 15 days after first spraying is recommended.

7. For effective management of brown plant hoppers and getting higher grain yield with higher economic return, spraying of Flonicamid 50% WG @ 3 g/10 Liter water after attaining ETL (10 hoppers at tillering stage and 5-10 hoppers at panicle stage) of pest, followed by second spraying of Pymetrozine 50 % WG @ 6 g/10 Liter water at 15 days interval is recommended.

8. For effective management of pink bollworm on cotton with higher economic returns, six releases of *Trichogrammatoidea bactrae* @ 1 lakh eggs/hectare at an interval of 10 days, starting from 55 days of crop germination is recommended.

9. For effective management of sorghum midge fly, increasing the grain yield and incremental cost benefit, at 50 % earhead emergence neem seed extract @ 5% and after 10 days dimethoate 30 % EC @ 16 ml/10 lit water spray is recommended.

10. *Steinernema bicornatum, Heterorhabditis indica and Steinernema siamkayi* were identified as the three parasitic nematodes isolated from guava garden soil. Considering the pathogenecity potential (mortality rate 51-85%) of these three parasitic nematodes against lepidopterous insects like *Helicoverpa armigera, Semilooper, Corcyra cephlonica and Galleria mellonella insects.* It is recommended to use them for registration in the group of useful microorganisms as well as for further study on pest control.

11. For the management of gummosis of Nagpur mandarin, Bordeaux paste (1: 1: 10) should be pasted twice, before the rainy season (May) and after the rainy season (October) regularly on the trunk of the plant. At the initiation of gummosis disease *Trichoderma harzianum* plus *Pseudomonas fluorescens* plus *Mycorrhiza* 100 g each should be mixed with 1 kg of FYM and apply at the periphery of each plant. It is also recommended to apply ferrous sulphate plus zinc sulphate @ 200 g each at the periphery of the plant at interval of 8 days.

Year : 2022

Plant Pathology

12. For effective management of greening disease in Nagpur mandarin application of 50% more phosphorus than recommended dose of fertilizer after stress release in three split doses (June, August and October) and recommended dose of Nitrogen and Potassium in five split doses (June, August, October, December and February) and after 15 days of the first split dose of fertilizer, soil application of Zinc Sulphate

and Ferrous Sulphate @ 200 g/plant each along with spraying of Tetracycline hydrochloride @ 6 gm / 10 liters of water at an interval of 45 days in the month of October to December is recommended.

Entomology

13. For the effective management of pod borer complex and for obtaining higher yield in pigeonpea, module Thiodicarb 75 WP 20 gm at 50 per cent flowering followed by Flubendamide 39.35 SC 2 ml at 15 days after first spraying followed by Lambda Cyhalothrin 5EC 10ml in 10 liters of water 20 days after second spraying is recommended.

14. For effective management to getting higher monetary returns against soybean stem fly by using Control Release Technology (CRT) seed treatment by mixing polykote polymer 4ml @ 4ml water with Thiamethaxon 30FS 10ml per kg seed and then it is recommended to spray Indoxacarb 15.8% EC @ 7 ml or Chlorantroniliprol 18.5% SC @ 3 ml in 10 liters of water after 45 days of sowing

15. Application of custard apple seed powder packed in cotton cloth @ 15g/kg of stored pigeon pea is recommended for management of pulse beetle.

16. For effective and economic management of stem borer, green leaf hopper, brown plant hopper, white backed plant hoppers and getting higher grain yield of rice crop, application of treatment with Chlorantraniliprole 0.4G @ 10 kg/ha at 30 DAT + Cartap hydrochloride 50% SP @ 20g/10 liter of water at 50 DAT + Triflumezopyrim 10% SC @ 4.8 ml/10 liter of water at 65 DAT and in gall midge endemic areas, for effective and economic management of gall midge, stem borer, green leaf hopper, brown plant hopper, white backed plant hoppers and getting higher grain yield of rice crop, application of treatment with Azadirachtin 1% EC @ 20 ml/10 liter of water at 30 DAT +Eucalyptus oil @ 20 ml/10 liter of water at 50 DAT + Cartap hydrochloride 50% SP @ 20 g/10 liter of water at 65 DAT is useful.

17. For effective management of Pigeonpea pod borers and to get higher economic returns, 3 sprays of Bacillus thuringiensis (NBAIR-BTG4 2%) @ 2 ml/L starting at 50 % flowering and subsequent sprays at 15 days interval is recommended**.**

Year : 2023

Plant Pathology

18. For seed treatment application of 25g/kg seed of GAKPR-16 as a biofertilizer should be applied for maximum yield of pigeon pea is recommended.

19. For getting higher yield of linseed and for effective management of powdery mildew disease, seed treatment with salicylic acid 50 PPM (50mg/kg seed) + two foliar spray of salicylic acid at 50 PPM (50 ml/l) at 30 and 45 DAS or 2 foliar spray of hexaconazole (0.1%) as soon as disease is appeared in the field and 2nd spray after 10 days interval if required is recommended

Inventory - IV

20. It is recommended that the occurrence of Alternaria blight disease in tomato 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.

Log_{10}

$Y = -19.6566 + (8.5456*Log_{10} X\ 0^{**}) + (0.0166*Log_{10} X\ 1^{**}) + (5.9282*Log_{10} X\ 2^{**}) + (-0.2453*Log_{10} X\ 3^{**}) + (-1.9385*Log_{10} X\ 4^{**}) + (1.2068*Log_{10} X\ 5^{**}) - 0.596$

Here,

Y = Disease intensity
X0 = Meteorological Week
X1 = Rainfall (mm)
X2 = Maximum Temperature (^{0}C)
X3 = Minimum Temperature (^{0}C)
X4 = Morning Relative Humidity (%)
X5 = Evening Relative Humidity (%)
** = Significant at 1% level of significance.

21. Post harvest treatment of 1000 ppm Neomycine and 1000 ppm Fluconazole used in combination for treatment of Nagpur mandarin fruits can restrict green mold (*P. digitatum) &* sour rot (*G. candidum)* diseases under ambient storage upto 15 days.

Entomology

22. For management of leaf miner pest in Nagpur Mandrin nursery, spraying of neem seed extract @ 5% at 30 days after bud sprouting followed by Imidacloprid 17.8 % SL @ 2.5ml /10 L water at pest initiation is recommended

23. For assessment of stem fly and girdle beetle infestation (% plant infestation) as well as to determine the % stem tunneling due to these stem tunnellers, for research workers (10 plants / 10 m_2 plot area) and such 5 spots per field (4 spots from 4 corners of the field 10 meter inside and 1 spot in the center of the field) for field diagnosis for extension workers is recommended.

Year : 2024

Plant Pathology

24. Application of Vermicompost @ 1.5 kg or compost @ 2 kg for 80 litres of water (0.1224 M^3) is recommended for getting better result for *Azolla* (*Azolla microphylla*) production.

25. For saving 25 per cent nitrogen dose in paddy crop, application *in situ* prepared *Azolla* (*Azolla microphylla*) @ 5 t /ha + 75 per cent recommended dose of nitrogen (50 kg N basal dose + 25 kg N as top dressing) is recommended.

26. For effective management of Mungbean leaf crinkle disease, seed treatment with Thiamethoxam 70 % WS @ 5 g/kg seed and spraying of Thiamethoxam 25 % WG @ 4 g/ 10 L of water at 21st and 35th days after sowing is suggested as research finding.

27. Application of fortified FYM with bio-decomposer (1kg / tree) and spraying of HMO @ 2% (200 ml/ 10 L water) in the months of July and August as a protective spray, as well as spraying of Hexaconazole 4% + Zineb 68% WP (combi product) @ 15 g/ 10 L water on the tree in November, is suggested as a research finding for integrated management of greasy spot of Nagpur mandarin.

28. Three spray of Potassium nitrate (1 kg) + pre-mixed fungicide Azoxystrobin 18.2% + Difenconazole 11.4% SC (100 ml) + GA3 (1 g) or Potassium nitrate (1 kg) + pre-mixed fungicide Tebuconazole 50% + Trifloxystrobin 25% WG (50 g) + GA3 (1 g) in 100 L water at first fortnight of April, August and September is suggested as research finding for effective management of ambia bahar fruit drop of Nagpur mandarin.

29. Two sprays of combi-fungicide, Azoxystrobin 18.2% + Difenoconazole 11.4%SC @ (10 ml/10 L), first at initiation of disease and second at 15 days after first spray found effective for management of leaf blotch and leaf spot disease of Turmeric.

Entomology

30. For effective management of stem borer and leaf folder and getting higher grain yield of rice crop, the below plant protection module is recommended.

- Soil application of Chlorantraniliprole 0.4 % GR @ 10 kg/ha at 10 days after transplanting.
- Installation of pheromone traps (Scirpolure) @ 8/ha in field at 15 days after transplanting.
- Three releases of *Trichogramma japonicum* @ 50,000 eggs/ha at 20, 30 and 40 days after transplanting.
- Spraying of Azadrachtin 1500 ppm @ 40 ml/10 liter of water at 50 days after transplanting. Spraying of Flubendiamide 39.35% m/m SC @ 1 ml/10 liter of water at 70 days after transplanting.

31. For effective management of stem borer and brown plant hopper and getting higher grain yield of rice crop, the below plant protection module is recommended.

- Soil application of Fipronil 0.6 % GR @ 10 kg/ha at 30 days after transplanting.
- Soil application of Chlorpyrifos 10 % GR @ 10 kg/ha at 45 days after transplanting.
- Spraying of Carbosulfan 25 % EC @ 16 ml/10 liter of water at 60 days after transplanting. Spraying of Fenobucarb 50 % EC @ 10 ml/10 liter of water at 75 days after transplanting.

32. For solid waste management with 87 per cent reduction in volume per quintal and for obtaining good quality compost in 22-30 days with more monetary returns, it is recommended to release approximate, 10,000 larvae of Black soldier fly (*Hermetia illucens*) (5 kg larvae) per quintal of kitchen waste is recommended.

33. For effective management of major pest complex of chilli from nursery to the last pickings with getting higher cost benefit ratio and also to minimize the harmful

effect by the continuous use of chemical insecticide following module is recommended.

In nursery:

- Seed treatment with Thiamethoxam 30% FS @ 7ml/kg of seed before sowing.
- Spray with Neem oil (CNO) 2% at 30 DAS
- Spray with Ethion 50% EC @ 2 ml/L at 45 DAS.

In field before transplanting

- Soil application of Neem cake 2.5qt/ha before transplanting

In field at the time of transplanting

- Seedling treatment with Imidacloprid 17.8% SL @ 0.5 ml/L forleaf portion followed by captan 75 % WP @ 1.7g/L root dipping for 10 min before transplanting.
- Growing of Maize as a border row

After transplanting

Installation Yellow Sticky trap (YST) along the crop canopy from 15 days after transplanting to maturity of the crop at a monthly interval.

- Spray of NSE 5% at 15 DAT.
- Spray of Fipronil 5% SC @ 2ml/L at 30 DAT.
- Spray of NSE 7% at 45 DAT.
- Spray of Acetamiprid 20% SP @ 0.2gm/L at 60 DAT.
- Spray of Spiromensifin 22.9% SC @ 0.8ml/L at 75 DAT.
- Spray of NSE 10% at 90 DAT.
- Collection & destruction of infested fruits and bigger size larvae of fruit borer, when the crop is at fruiting stage
- Spray of Imidacloprid 17.8% SL @ 0.5 ml/L at 105 DAT.
- Spray of Spinosad 45% SC @ 0.32 ml/L at 120 DAT
- Spray of Emamectin benzoate 5% SG @ 0.4 g/L at 135 DAT.
- Spray of Fenpropathrin 30% EC @ 0.35 ml/L at 150 DAT.

34. For trapping of maximum moth catches of pink bollworm, it is recommended to switch on the lamp of light trap for the period of 3.30 to 5.30 am. in morning or from 6.00 to 8.00 pm at evening.

35. For effective management of major insect pests of sunflower and getting maximum monetary returns

- Seed treatment with Imidacloprid 48% FS @ 5 ml/kg seed, spraying of cypermethrin 10 % EC @ 1.5ml/lit at starbud and flowering stage of crop.

or

Seed treatment with Thiamethoxam 30 % FS @ 3 ml/kg seed, spraying of cypermethrin 10 % EC @ 1.5ml/lit at starbud and NSE 5 % at flowering stage of crop is recommended.

36. Safflower genotype *viz.* AKS-351 is recommended as a donor for tolerant to aphids.

Year 2025

Plant Pathology

37. Alemow (*Citrus microphylla*) is recommended as a *Phytophthora* root rot tolerant rootstock due to its low susceptibility to root rot, the least feeder root rot rating and leaf fall percentage, and the lowest population density of *Phytophthora*.

38. For effective management of sooty mould disease in acid lime orchards, it is recommended to apply two sprays of mineral oil micro-emulsion adjuvant @ 5 ml per liter of water at an interval of 15 days as soon as black mold appears on the foliage.

39. *Hypocrella raciborskii* (Aschersonia) is recommended as a beneficial effective entomopathogen of citrus black fly.

Entomology

40. For effective management of pests like citrus psylla, fruit flies and fruit sucking moth causing fruit drop in Nagpur mandarine during *Ambia bahar* and for getting higher fruit yield with better economic returns it is recommended to adopt following plant protection module:

Plant Protection Module

June-July	• Installation of Yellow sticky traps 30/acre on 2.0 mtr height from soil surface from 1st week of June (trap change at monthly interval). • Spraying of neem oil 10 ml / L (1 %) with detergent powder at new flush during 1st week of June. • Foliar application of imidacloprid 17.8 % SL @ 0.5 ml / L of water during 1st week of July.
August-September	• Foliar application of neem oil 10 ml / L (1 %) with detergent powder during 1st week of August. • Foliar application of thiamethoxam 25 % WG @ 0.3 g/L water during 1st week of September. • Installation of poison bait consisting of malathion 50 % EC @ 10 ml + 100 g *Jaggary* + 100 ml mandarin juice + 900 ml of water (two bottles of poison bait per 25-30 trees) with a 60 watt bulb fixed over it to attract moths during night time during 2nd week of September
October-November	• Installation of methyl eugenol trap @ 20 / ha during 1st week of October [change lure at every 15-20 days interval].

- Application of karanja oil @ 20 ml / L (2 %) with detergent powder during 1st week of October.

OR

June-July

- Spraying of karanja oil @ 20 ml / L (2 %) with detergent powder at new flush during 1st week of June.
- Foliar application of thiamethoxam 25 % WG @ 0.3 g/L of water during 1st week of July.

August-Septembe

- Foliar application of imidacloprid 17.8 % SL @ 0.5 ml / L of water during 1st week of August.
- Installation of methyl eugenol trap @ 20 / ha during 1st week of August [change lure at every 15-20 days interval]
- Foliar application of thiamethoxam 25 % WG @ 0.3 g/L of water during 1st week of September.
- Generation of smoke in late evening hours in orchards to repel the adult of fruit sucking moth from 1st week of September onward

October-November

- Periodical collection and destruction of fallen fruits under trees at weekly interval starting from 1st week of October.
- Foliar application of neem oil @ 10 ml / L water (1%) with detergent powder during 1st week of October.

41. For effective management of onion thrips and for getting higher bulb yield with better return following plant protection module is recommended.

- Installation of yellow and blue sticky traps @ 5 each/ acre at 20 days after transplanting.
- Spraying of neem oil 300 ppm @ 300 ml/10 L of water at 40 days after transplanting.
- Spraying of *Verticillium lecanii* 3.0 % AS @ 50 g / 10 L of water at 55 days after transplanting.
- Spraying of deltamethrin 11 % EC @ 3 ml/ 10 L of water at 70 days after transplanting.
- Spraying of fipronil 80 % WG @ 1.5 G /10 L of water 85 days after transplanting.

OR

- Spraying of lambda-cyhalothrin 5% EC @10 ml/10 L of water 40 days after transplanting.
- Spraying of dimethoate 30 EC @13.2 ml/10 L of water 55 days after transplanting.
- Spraying of deltamethrin 11% EC @3 ml/10L of water 70 days after transplanting.
- Spraying of fipronil 80 % WG @ 1.5 G /10 L of water 85 days after transplanting.

42. For effective management of sap-sucking pests on chilli, brinjal and tomato it is recommended to use 30 micron silver polythene mulch on soil at the time of transplanting these crops.

43. For effective management of gram pod borer on chickpea and getting higher returns, spraying of emamectin benzoate 5 % SG @ 4.4 g at 50 per cent flowering followed by spraying of a combi product, novaluron 5.25 % + indoxacarb 4.50 % SC @ 16.5 ml in l0 liters of water, 15 days after first application is recommended.

44. For effective management of linseed bud fly and getting higher yield, two applications of PDKV *Dashparni* extract [5 parts of neem leaves + 2 parts each of Ghaneri (*Lantena camera*), *Karanj* (*Pongamia pinnata*), Kanher (*Nerium indicum*), Castor (*Ricinus communis*), Gulvel (*Tinospora cordifolia*), Custard apple (*Annona squamosa*), Rui (*Calotropis procera*), Papaya (*Carica papaya*) and Nirgudi (*Vitex negundo*) leaves) or neem seed extract prepared by Rosukon method (i.e. fermentation of 3 parts of botanical + 1 part jiggery in 10 parts water for 3 months) @ 300 ml per 10 L of water at 10 days interval from bud initiation stage is recommended.

45. For effective management of thrips and leafhoppers on summer groundnut and getting higher monetary returns, spraying of neem seed extract 5% at 15 days after seed germination followed by spraying of quinolphos 25% EC @ 28 ml/ 10 L of water at 30 days after seed germination is recommended.

46. For effective biorational management of citrus black fly after the initiation of infestation two sprays of entomapathogenic fungus *Aschersonia aleyrodis* (CFU 1.5 x 10^{8} spore/ml) @ 20ml / 10 L of water at 15 days interval is recommended (Research Finding).

47. For effective management of chilli thrips and mites and for getting increased yield with maximum net return following plant protection module is found effective:

- Sweeping of castor oil treated white muslin cloth (6m x 2m) on crop in morning hours + installation of blue & yellow sticky traps (60:40) @ 40/acre and spraying of neem oil @ 3% + propergite 57 EC @ 30 ml in 10 L water at 15 days after transplanting
- Spraying of emamectin benzoate 0.5 SG @ 4 gm+ propargite 57 EC @ 30 ml in 10 L water at 30 days after transplanting
- Spraying of bioinnoculant (*Verticilium lecani + Metarrhizium anisoplae + Beauveria bassiana) @* 40 ml in 10 L water at 45 days after transplanting
- Sweeping of castor oil treated muslin white cloth (6mx2m) on chilli crop in morning hours + installation of blue & yellow sticky traps (60:40) @ 40/acre and spraying of neem oil 3% + propergite
- 57 EC @ 30ml in 10 L of water at 60 days after transplanting Spraying of mixed insecticide flubendamide 19.92% + thiacloprid 19.92% @ 5ml /10 L water at 75 days after transplanting.

Inventory - IV

3.4. AGRICULTURAL ENGINEERING & TECHNOLOGY

Year : 2020

1. 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.
2. 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.
3. 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.
4. It is recommended to cultivate tomato in 50 percent white shednet house with 50 micron plastic mulching for higher fruit yield.
5. 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.
6. 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.
7. It is recommended to establish 50 m3 fixed dome biogas for institutional dairy for 6 kW power generation
8. 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) for higher growth and yield of Okra crop with highest B:C ratio.
9. For higher onion bulb yield and economic returns it is recommended to apply 120 per cent of RDF (120:60:60 NPK, kg/ha) with crop spacing of 10 x 7.5 cm, under drip fertigation.

Year : 2021

10. It is recommended to prepare Nagpur mandarin juice powder with soy protein isolate (2.10%), GMS (2.75%), CMC (1.75%), sugar content (5.50%) and whipping time (8 min) and dry in microwave drying at 540W microwave powder and 3mm drying bed thickness.

    OR

    It is recommended to prepare Nagpur mandarin juice powder with soy protein isolate 3.30%, guar gum 0.45%, sugar content 10% and whipping time 6 min microwave drying at 540W microwave powder and 3mm drying bed thickness.

11. It is recommended to use Ashwagandha, Shatavari, Gudwel, Kandwel and Bramhi powder in wheat flour for cookies preparation.

12. Paddy growing farmers of Vidarbha region are advised to cultivate paddy on the 40 micron plastic mulching.

13. It is recommended to install decentralized on grid Solar PV Power Plant for Electricity Generation in Institutional Buildings in view to Initiate Green Energy Utilization, Energy Conservation, Revenue Generation and Environmental Protection.

Year : 2022

14. It is recommended to use the well water after quality analysis from the vicinity area of sewage drain for irrigation in agriculture instead of direct use of raw sewage water to reduce the heavy metal pollution**.**

15. It is recommended to use biogas purification system containing absorbents viz. laterite soil, NaOH solution, activated carbon and silica gel for reducing quantity of CO_2 and H_2S in order to upgrade quality of biogas and increase the storage capacity.

16. It is recommended to use Scheffler solar collector of aperture area16 m^2 for the extraction of essential oils from medicinal and aromatic plants like 24 hous shade dried Lemon grass and Palmarosa grass by hydro distillation method in sunny days.

17. It is recommended to use extract of Ashwagandha 2.00 g, Shatavari 3.25 g, Gudwel 2.00 g, Kandwel 1.75 g and Bramhi 0.5 g in 100 g wood apple pulp for jelly preparation

18. It is recommended to use Ashwagandha 2.50 g, drumstick leaves powder 5.00 g, Gudwel 2.50 g, Kandwel 2.75 g, ginger 4.00 g and Shatavari 2 g in 1000 g wheat and maize (proportion 9:1) flour for pasta preparation.

19. It is recommended to use Linseed 50%, 35% of dates and 15% Oats of for preparation of 1 Kg linseed oats shots having 50 days keep quality in glass jar.

20. It is recommended to use Linseed 60%, Dry Dates powder12%, Almond 12%, Cashew 12% and Raisins 4% of for preparation of 1 Kg linseed dry fruit laddu having 50 days keep quality in glass jar.

21. It is recommended to use Linseed 60%, Fennel 12%, Carom seed 8%, Sesame seed 8%, Split Coriander seed 4% and Watermelon seed 8% of for preparation of 100 linseed Mukhwas having 50 days keep quality in glass jar.

22. It is recommended to use PDKV Low Cost Portable On-Farm Cooling Storage Structure with 2 tonnes capacity for short term storage of vegetables (tomato, cucumber, okra, capsicum).

Year : 2023

23. For preparation of value added Mahua burfi, it is recommended to use 25% crushed dried mahua flowers and 30% sugar to the weight of cow milk khoa.

Inventory - IV

24. For preparation of guava toffee having storability ninty days, guava pulp : sugar: butter : skim milk powder (1: 1: 0.1 : 0.1) proportion is recommended .

25. For preparation of quality lime blended mandarin marmalade (TSS 65^{0}B) eatable up to three months, 55 % Nagpur mandarin juice + 5 % lime juice + 6.2 % Nagpur mandarin peel shreds is recommended.

26. For maintaining the quality of custard apple fruits during distance transportation and longer shelf life, fruit wrapping with foam net and placed in ventilated corrugated boxes along with 2 sachets of 1 g ethylene absorbent is recommended.

27. It is recommended that, the dugout type farm pond constructed on farmers field should have the existing bund (1.5 m height) or grown the vegetative barrier (1.3 - 1.5 m height) around the farm pond to save the storage losses up to 27.97 percent.

28. In dryland agriculture, for Western Vidarbha Zone on medium deep black soil having average slope of 1%, it is recommended that from 1.0 ha catchment area on an average 457m_3 runoff was stored in the farm pond which can be utilized to irrigate about 0.91 ha area during *kharif* or *rabi* season with one protective irrigation of 5 cm depth.

29. It is recommended to use Dr. PDKV developed weekly mean reference evapotranspiration for determining water requirement of different crops for all tahsils of Vidarbha. Similarly, it is recommended to use maps developed in GIS for determining mean reference evapotranspiration of specific week at specific location.

30. PDKV developed process technology for the production of nutria-snack product, prepared with 1 kg blend ratio of sorghum, corn and proso millet (60:30:10) with powder of 5g ashwagandha, 9g ginger, 2g of gudwel and 2g of drumstick leaves at 15% moisture content having 90 days storage life is recommended.

31. PDKV developed processing machinery under Value Chain on Pulses is recommended for processing of pulses, preparation of different value added products and employment generation.

32. **"**PDKV UV-Assisted Treatment Device" developed for Nagpur Mandarins is recommended for treatment of Sweet Orange fruits after reducing RPM (10 rpm) of conveyor belt, to provide 5 min Pre-wax UV-C (254 nm) exposer followed by 10% edible wax coating without fungicide for post harvest decay control under ambient storage conditions.

33. It is recommended to use PDKV developed multi-tier hydroponic structure with Nutrient Film Technique of size 2 x 1.1 x 3 m made up of PVC pipe (75 mm) and UPVC pipe (25 mm) for cultivation of leafy vegetables**.**

34. It is recommended to use PDKV developed Low Cost Portable Onion Storage Structure with 15 q capacity for storage of rabi onions up to 150 days.

35. It is recommended to use puf roof for reducing the inside temperature of poultry house structure (2x1.1x 3 m).

36. PDKV developed Gas Evolved Device is recommended for the quality detection during fruits and vegetables storage.

Year : 2024

37. PDKV developed horizontal well recharge filter with combination of coarse sand, gravel, charcoal and gravel (4:2:2:2) of dimensions 2.0m x 0.60m x 0.45m is recommended for well recharging.

38. It is recommended to use the crop coefficient values given in table for determining water requirement of summer sesame crop.

Week after sowing	Crop coefficient	Week after sowing	Crop coefficient
1	0.43	10	1.3
2	0.55	11	1.29
3	0.68	12	1.23
4	0.81	13	1.12
5	0.93	14	0.97
6	1.05	15	0.77
7	1.15	16	0.57
8	1.23	17	0.47
9	1.28		

Alternative for above table following equation is recommended.

$$Kc_t = -3.7933\left(\frac{t}{T}\right)^3 + 2.2841\left(\frac{t}{T}\right)^2 + 1.6237\left(\frac{t}{T}\right) + 0.3229$$

Kc_t - Crop coefficient of t^{th} day.
t - Day after sowing
T - Total period of crop

39. It is recommended to use the crop coefficient values given in table for determining water requirement of summer green gram crop.

Week after sowing	Crop coefficient	Week after sowing	Crop coefficient
1	0.43	10	1.3
2	0.55	11	1.29
3	0.68	12	1.23
4	0.81	13	1.12
5	0.93	14	0.97
6	1.05	15	0.77
7	1.15	16	0.57
8	1.23	17	0.47
9	1.28		

Alternative for above table following equation is recommended.

$$Kc_t = -3.8882\left(\frac{t}{T}\right)^3 + 3.9756\left(\frac{t}{T}\right)^2 + 0.1172\left(\frac{t}{T}\right) + 0.5182$$

Kc_t - Crop coefficient of t^{th} day.
t - Day after sowing
T - Total period of crop

40. For estimation of near real time spatial and temporal crop coefficient values and getting accurate water requirement of rabi wheat and onion, it is recommended to use Normalized Difference Water Index (NDWI) based following equations:

    For wheat: $Kc = 3.608 \times NDWI + 0.433$

    For onion: $Kc = 3.231 \times NDWI + 0.603$

41. PDKV developed naturally ventilated double burner biomass cook stove is recommended to use for cooking.

42. PDKV solar powered biomass-based air purifier is recommended to purify indoor air.

43. Tractor operated MPUAT Cotton Stalk Shredder with Dr. PDKV modified sweep is recommended for shredding and uprooting of cotton.

44. It is recommended to install 3 UV-C tubes of 254 nm wavelength and 30 watts capacity behind 5000 CFM Air Handling Unit (AHU) in 15.4 mm x 18.29 m x 9.14 m size cold rooms and switch ON for 2 hours every day for reducing microbial load of air in cold rooms and rottening of stored Nagpur Mandaring of Stored Nagpur Mandarin fruits.

45. PDKV developed tractor operated mobile dal mill is recommended for wheat cleaning and grading.

46. It is recommended to use PDKV developed Ventilated Onion Storage structure (capacity 10 tonnes) for storage of rabi onions up to 180 days.

47. It is recommended to use PDKV onion spoilage detection device for early detection of onion spoilage in onion storage structure having capacity of 2.5 tons.

Year : 2025

48. PDKV developed seepage meter is recommended to measure seepage (Seepage and Percolation) losses from pond.

49. PDKV developed IoT based instrument used to measure evaporation and seepage losses with accuracy 98 per cent for management of store water in the farm pond to scheduling the irrigation is recommended.

50. Combination of 70:30 (Farm Pond Water: Ground Water) is recommended for irrigation to cotton, pigeon pea and chick pea for higher productivity in Purna valley of Vidarbha region.

51. It is recommended to use the crop coefficient values given in table for determining water requirement of cotton crop.

Week after sowing	Crop coefficient	Week after sowing	Crop coefficient
1	0.54	13	1.19
2	0.57	14	1.20
3	0.62	15	1.19
4	0.68	16	1.17
5	0.75	17	1.13
6	0.83	18	1.08
7	0.90	19	1.02
8	0.97	20	0.95
9	1.04	21	0.87
10	1.09	22	0.79
11	1.14	23	0.71
12	1.17	24	0.62

Alternative for above table following equation is recommended.

$$KCt=5.9961 \left(\frac{t}{T}\right)^4 - 14.115 \left(\frac{t}{T}\right)^3 + 8.3452 \left(\frac{t}{T}\right)^2 + 0.1003 \left(\frac{t}{T}\right) + 0.5285$$

Kc_t - Crop coefficient of t^{th} day.

t - Day after sowing

T - Total period of crop

52. It is recommended to use the crop coefficient values given in table for determining water requirement of pigeon pea crop.

Week after sowing	Crop coefficient	Week after sowing	Crop coefficient
1	0.54	14	1.15
2	0.56	15	1.16
3	0.59	16	1.16
4	0.64	17	1.15
5	0.70	18	1.13
6	0.76	19	1.10
7	0.82	20	1.05
8	0.88	21	1.00
9	0.94	22	0.94
10	1.00	23	0.87
11	1.05	24	0.79
12	1.09	25	0.72
13	1.13	26	0.64

Alternative for above table following equation is recommended.

$$KCt=5.3467 \left(\frac{t}{T}\right)^4 - 13.253 \left(\frac{t}{T}\right)^3 + 8.3885 \left(\frac{t}{T}\right)^2 + 0.3899 \left(\frac{t}{T}\right) + 0.5476$$

Kc_t - Crop coefficient of t^{th} day.

t - Day after sowing

T - Total period of crop

53. For clay loam soils in western Vidarbha region, it is recommended that the overhead sprinkler (4ft, 9 lpm, 50% overlapping) should be operated for four hours during critical stages of chickpea i.e. flowering and pod formation to maintain favourable moisture content in the root zone.

54. For high density plantation of Nagpur mandarin with spacing of 6m x 3m (Fully matured), application of water soluble fertilizers through drip fertigation with the dose of 663-220-330 (N-P-K, g/pant) or 368-122-183, (N-P-K, kg/ha) in 18 splits at 14 days interval as per schedule given below is recommended for getting higher yield and superior quality of fruits, with more economic returns.

Split schedule for fertigation:

S.N.	Stage	No of Days	No of splits	Split No	Quantity of fertilizers through drip g/plant					
					N		P		K	
					g/plant	kg/ha	g/plant	kg/ha	g/plant	kg/ha
1	Blossom	42	03	1	55.24	30.66	21.98	12.2	27.48	15.25
				2	55.24	30.66	21.98	12.2	27.48	15.25
				3	55.24	30.66	21.98	12.2	27.48	15.25
2	Fruit set	42	03	4	55.24	30.66	21.98	12.22	7.48	15.25
				5	55.24	30.66	21.98	12.2	27.48	15.25
				6	55.24	30.66	21.98	12.2	27.48	15.25
3	Fruit Growth Stage 1	84	06	7	38.67	21.46	7.32	4.06	16.49	9.15
				8	38.67	21.46	7.32	4.06	16.49	9.15
				9	38.67	21.46	7.32	4.06	16.49	9.15
				10	38.67	21.46	7.32	4.06	16.49	9.15
				11	38.67	21.46	7.32	4.06	16.49	9.15
				12	38.67	21.46	7.32	4.06	16.49	9.15
4	Fruit Growth Stage 2	84	06	13	16.50	9.16	7.32	4.06	10.99	6.1
				14	16.50	9.16	7.32	4.06	10.99	6.1
				15	16.50	9.16	7.32	4.06	10.99	6.1
				16	16.50	9.16	7.32	4.06	10.99	6.1
				17	16.50	9.16	7.32	4.06	10.99	6.1
				18	16.50	9.16	7.32	4.06	10.99	6.1
	Total	**252**	**18**		**663.06**	368	**220**	**122**	330	**183**

55. It is recommended to use the mixture of crop residues of cotton and pigeon pea crop having particle size 4 mm, 30 ± 2 per cent moisture content and pyrolysed biochar 10 per cent for enhancing the quality of pellets during pelletisation through double roller flat die type pelleting machine.

56. For preparation of millet based PDKV cookies, flour mixing speed with other ingredients as 400 rpm for 20 min and baking temperature of 180°C for 20 min is

recommended along with following pre-treatments,

a. Sprouting for pearl millet and proso millet grain

b. Pearling for finger millet grain

c. Blanching for sorghum grain.

57. For preparation of millet based PDKV cupcake, flour mixing speed with otheringredients as 200 rpm for 15 min and baking temperature of 180°C for 25 minis recommended along with following pre-treatments,

a. Sprouting for pearl millet and sorghum grain

b. Blanching for finger millet grain

c. Pearling for proso millet grain.

58. For preparation of millet based PDKV toast, flour mixing speed with other ingredients as 400 rpm for 20 min and consecutive baking temperature of 180°C and 160ºC for 25 and 20 min respectively is recommended along with following pre-treatments,

a. Blanching for pearl millet and sorghum grain

b. Sprouting for finger millet grain

c. Pearling for proso millet grain.

59. For preparation of millet based PDKV bread stick, flour mixing speed with other ingredients as 400 rpm for 15 min and baking temperature of 180°C for 15 minis recommended along with following pre-treatment

a. Pearling for pearl millet and proso millet grain

b. Sprouting for finger millet grain

c. Blanching for sorghum grain is recommended.

60. PDKV developed process for pectin extraction from Nagpur mandarin peel is recommended for maximum pectin recovery.

61. PDKV-developed mocktail processing technology is recommended for preparation of mocktail from Nagpur mandarin fruit, after removal of peel the fruits blanched for 5 minutes and extracted juice used for the preparation of mocktail and storing it in glass bottles for up to 90 days.

62. It is recommended to use PDKV developed hydroponic structure (length 25 m, width 19.5 m, height 5.5 m) for growing of leafy greens.

Salient Features:

- NFT pipe length : 6 m
- No. of holes per pipe : 35
- No. of channels : 18
- Total no. of holes : 6300

63. It is recommended to use PDKV developed sensor based IoT device for monitoring and controlling environmental parameters (Temperature: 22-25°C, humidity 60-80 % and light intensity less than 80,000 lux) in protected structures.

3.5. ANIMAL HUSBANDRY & DAIRY SCIENCE

Year : 2021

1. Feeding of 3 kg concentrate (>18 % CP) per day from 08 weeks before probable day of calving is recommended to the crossbred Jersey cows having average 300 (± 50) kg body weights for better health of calf and increase in milk production.
2. Under intensive poultry rearing system, supplementation of 3% linseed oil is recommended in the feed of Giriraja birds to enriched omega-3 in the meat with higher body weight gain.
3. Preparation of value added Kalakand is recommended for blending 15% ripe wood apple pulp (2.5 % of milk) in cow milk chhana with 5 days under room temperature & 20 days on refrigerated temperature to maintain keeping quality.

Year : 2022

4. Blending of 4 per cent ginger juice and 0.4 per cent turmeric powder in kulfi mix is recommended to produce good quality value added PDKV Herbal Kulfi.

Year : 2024

5. Feeding of 2 % common salt treated soybean straw in standard ration is recommended to maintain and improve the health and milk production of cows.
6. For the preparation of good quality value added kulfi by traditional method used 50% evaporated cow milk, 14 % crushed dried Mahua flowers and 13 % sugar by weight of mix is recommended
7. It is recommended that, use of 4 % Dragon fruit pulp and 40 % sugar in buffalo milk chakka for preparation of good quality value added shrikhand.
8. For preparation of good quality value added gulabjamun from cow milk khoa blending with 30 % matured unripe steamed banana pulp and 10 % wheat flour by weight of mix is recommended.

Year : 2025

9. For preparation of good quality value added Paneer Whey beverage blending of 15 % Pomegranate juice with 0.5 % Ginger extract, 0.3 % Beetroot juice and 8 % Sugar in Paneer Whey is recommended.

3.6. SOCIAL SCIENCE

Year : 2020

Agricultural Economics:

1. 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.

Agril. Extension Education:

2. 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.

Year : 2021

Agricultural Economics

3. The farmers earned gross economic benefit of Rs. 841.68 Crores during last six year from PKV Tara variety of pigeon pea released by Dr. PDKV, Akola. It is therefore recommended that government should strengthen the University for further research and extension of improved varieties for the benefit of farmers.
4. The farmers earned gross economic benefit of was Rs.1383.20 Crores during last fifteen years from Kopergaon variety of green gram and Rs. 3904.72 Crores during last fifteen years from TAU 1 variety of black gram released by Dr. PDKV, Akola. Considering the farmers demand for seed of Kopergaon & TAU 1 variety, it is need to increase the seed production. It is therefore recommended that government should strengthen the University for further research and extension of improved varieties for the benefit of farming community.
5. The farmers earned gross economic benefit of Rs. 2174.22 Crores during the last fifteen years from TAG 24 variety of groundnut released by Dr. PDKV, Akola. Considering the farmers demand for TAG-24 seed, there is need to increase the seed production. It is therefore recommended that government should enable to the University for further Research and Extension of improved varieties for the benefit of farming community.

Agril. Extension Education:

6. Drill method of paddy cultivation is found economically more beneficial among conventional transplanting, SRI and broadcasting methods. The major constraints found in adoption of drill method of paddy cultivation were non availability of drill paddy machine at proper time of sowing (82 %), no subsidy on drill paddy machine

(74%) and high cost of drill paddy machine (71%). It is therefore recommended that drill paddy machine should be made available to the farmers at subsidized rate under agriculture mechanization scheme of State Department of Agriculture for increasing the area under drill paddy cultivation.

Year : 2022

Agricultural Economics:

7. The Agri entrepreneur earned Rs. 5226.98 crores and Rs. 31893.45 crores as net economic benefit and gross economic benefit respectively during last 32 years from PKV Mini Dal mill develop by Dr. PDKV, Akola. Hence, it is recommended that government should increase subsidy on the prevailing subsidy on PKV mini dal mill. It will encourage employment opportunities in rural areas.

8. Dr. PDKV, Akola, developed Katol gold variety provided Gross economic benefit of Rs. 653.09 Crores and Net economic benefit of Rs. 460.04 Crores to the farmers during the fourteen years. Therefore, it is recommended that the government should provide the sufficient funds for expansion and extension of Katol gold variety of Dr. PDKV, Akola.

Year : 2023

Agril. Extension Education

9. Due to Soil Health Card programme it is observed that, there was 15.92 per cent increase in productivity, 16.92 per cent increase in income and overall impact was 16.03 per cent on the paddy growers. It is therefore, recommended that, Soil Health Card Programme should be effectively implemented for longer period through extension functionaries.

10. It is observed that there was 21.45 per cent increase in area of PKV-Tara on paddy bunds in Eastern Vidarbha Zone. Therefore, it is recommended that, the extension agency should encourage the sowing of pigeon pea on paddy bunds on large scale in paddy area.

11. Due to adoption of sprinkler irrigation scheme implemented through PoCRA, the area under irrigation for rabi gram crop has been increased by 41.17 per cent, productivity increased by 40.49 per cent and annual income increased by 25.04 per cent. It is therefore recommended that for more effective adoption of sprinkler irrigation method in saline track of Vidarbha region, the extension agency should encourage for maximize farmer participation.

12. From the study on constraints faced by shed net growers in cultivation of vegetable crops, it is observed that there is frequent damage of shed net structure and crops grown in shed net due to natural calamities. It is therefore recommended that Government should make provision of insurance for shed net structure to mitigate the losses due to natural calamities.

13. Cotton productivity has been increased 30 per cent by adoption of IPM recommended technology. Therefore, it is recommended that, the IPM technology promoted and disseminated through the extension agencies for wide adoption.

14. The area under groundnut crop in Nagpur district has been steadily decreasing by 9.81 per cent per annum during the last two decades. Losses of groundnut crop mainly due to attack of wild animals was found to be responsible for the reduction in the area. Hence, it is recommended that the forest department should take appropriate measures to prevent the damage caused by the wild animals to the crop.

Agricultural Economics

15. Based on the results of crop concentration and diversification in Western Vidarbha region the area and production of Jowar and Bajara has decline continuous during last three decades by 9.84, 12.73 per cent and 11.05, 9.62 per cent per annum respectively. It is therefore recommended that, more concentration to increase the area under these crops.

16. In Eastern Vidarbha Zone due to B:C ratio realised by the farmers adopting drilled paddy-based gram cropping system (1:1.58), drilled paddy-linseed (1:1.35) and drilled paddy-lathyrus (1:1.26) are found economically feasible. Hence all the three drilled paddy-based system are recommended as per availability of resources with the farmer.

17. Considering the maximum cry gene frequencies and higher insecticidal toxicities of PDKV-SY-4, PDKV-SA-6 and PDKV-SGd-1, while at par toxicities and cry gene frequencies recorded for PDKV-SA-18, PDKV-SA-20, PDKV-SAK-6, PDKV-SAK-9, PDKV-SGn-4, PDKV-SGn-5, PDKV-SBn-2, PDKV-I-3 strains than the reference *Bt* strain HD-1, it is recommended that all these 11 PDKV *Bacillus thuringiensis* strains be registered in the group of useful microorganisms and further may be used in plant protection studies.

Year : 2024

Agricultural Extension Education

18. Rural youth has positive towards different agri-enterprises. They mostly preferred dairy farming, poultry farming, fishery and vegetable farming agri-enterprises. Hence it is recommended that the extension functionaries, concern development agencies and policy makers should promote dairy farming, poultry farming, fishery and vegetable farming as an agri-enterprises for the rural youth of Eastern Vidarbha Zone by providing them production and marketing related technical knowledge and skill-oriented trainings and financial support.

19. Non availability of protective accessories like hand gloves, nose mask and goggle in local market was the major constraint reported by most of the farmers. Hence it is recommended that protective covers like hand gloves, nose mask & goggle shall be made available to purchaser to minimize health hazards during insecticide spraying.

20. *Phytotpthora* management practices under TOT RKVY project had positive technological impact on tree canopy improved by 27.74 per cent, gum oozing controlled by 29.82 per cent, fruit drop controlled 32.43 per cent, fruit quality improved by 28.34 per cent, yield increased by 22.77 per cent and overall impact on Mandarin growers was 29.31 per cent. It is therefore recommended that, improved *Phytotpthora* management practices should be effectively implemented through the schemes of State Agriculture Department.

21. Majority of the Bt. Cotton growers were observed in medium level of knowledge (66.00%) and adoption (64.00%) about integrated nutrient management practices. Therefore, it is recommended that, extension agencies should organize training programmes, farmer field school and demonstration for the Bt. Cotton growers on integrated nutrient management practices.

22. Major technological gap in the summer groundnut cultivation by the farmers were found in seed treatment (67.50%), fertilizer application (56.66%) and plant protection measures (53.33%). It is therefore, recommended that, while organising the demonstrations and training programme on groundnut cultivation, the major emphasis should be given on recommended seed treatment, fertilizer application and plant protection measures by the extension agencies.

23. PDKV online *e-shetkari sanwad* advisory programme is highly effective expressed by the farmers 78 per cent and it helped to increase in the knowledge (74%), adoption (60%) and crop yield (20%) of farmers. Hence, it is recommended that time saving and cost effective PDKV online *e-shetkari sanwad* advisory model shall be adopted and popularise by the extension agencies to provide agricultural advisory to the farmers.

Agricultural Economics

24. The benefit cost ratio in Soybean cultivation by using BBF Planter (1.62) developed by PDKV, than conventional method (1.16). The variable cost was reduced at 16147.00/- Rs./ha. by using BBF planter method over the conventional method. On the other hand, the additional returns was increased at 24043.00/- Rs/ha. Hence, it is recommended that, Soybean cultivation by using BBF Planter developed by PDKV need to be popularized through extension functionaries for higher returns with low cost.

25. Amongst the five marketing channels of small size oranges, the highest market margin (Rs. 4826/- per qt) was estimated for channel of Producer → Wholesaler → Processing firm → Super stockiest → Dealer → Retailer → Consumer. Hence, it is recommended that, producer need to be sell their low grade orange through this channel for better remunerative prices.

26 The Benefit Cost Ratio of Tricho-card beneficiary (1:1.43) cotton farmer was more profitable than non-beneficiary (1:1.16). Similarly production has been increased by 19.38 per cent with gross returns of 22136Rs./ha (20.26 per cent more) due to use of Tricho-card technology in cotton cultivation. Hence, it is recommended that

Tricho-card technology need to be promoted and disseminated through the extension agencies, along with timely and sufficient availability of Tricho-card at taluka level.

27. Summer paddy (1:1.86) and summer mung (1:1.56) were economically profitable in Eastern Vidarbha Zone. The cost of cultivation of paddy was found (108140/-Rs./ha) higher than mung (49123/-Rs./ha). Crop duration and total number of irrigations required for mung (60-65 days and 6 Nos.) was less than paddy (115-120 days and 29 Nos.). Hence it is recommended that the farmer those having limited availability of capital and irrigation may be cultivate mung during summer season in Eastern Vidarbha Zone.

28. The Benefit Cost Ratio of Tricho-card beneficiary (1:1.29) paddy farmer was more profitable than non-beneficiary (1:1.13). Similarly production has been increased by 11.20 per cent with gross returns of 8930.07 Rs./ha (11.18 % more) due to use of Tricho-card technology in paddy cultivation. Hence, it is recommended that Tricho-card technology need to be promoted and disseminated through the extension agencies, along with timely and sufficient availability of Tricho-card at taluka level.

29. It is recommended that, for Groundnut and Linseed of Small, Medium and Large processing unit should process minimum oil production (Break Even Point) as given below.

Size of unit	Linseed Oil (KG)	Groundnut Oil (KG)	Total Oil (KG)
Small	502.91	828.37	1331.28
Medium	1459.98	1228.19	2688.17
Large	1838.17	1575.06	3413.23

30. Amaranths crop production was economically profitable to the farmers with B. C ratio 1: 2.75, therefore, it is recommended that, extension agencies should promote and disseminate the amaranths cultivation in the region for wider adoption.

31. Paddy productivity has been increased by 19.84 per cent with reduction in the cost of Rs. 7375.89/- per hectare in high level of adoption of Integrated Pest Management Technology. Hence, it is recommended that, the IPM technology need to be promote and disseminate through the extension agencies for wider adoption in paddy.

Year : 2025

Agricultural Extension Education

32. According to the study, 31.18 per cent of Agricultural Technical School diploma holders are engaged in entrepreneurship in areas such as dairy farming, poultry farming, goat rearing, vegetable cultivation, and vermicomposting. Meanwhile, current students are primarily interested in agricultural value-added products

(81.25%), dairy farming (77.80%), poultry farming (65.42%), fruit and vegetable production (62.50%) and goat rearing (46.67%).

Therefore, it is recommended that relevant institutions should establish specialized study modules related to these areas in Agricultural Technical Schools for providing hands-on technical training facilities to the students.

33. In the study of technological gap in adoption of fruit drop management practices in mandarin, higher technological gap was found in drainage management (82.50%), proper selection of soil (77.91%), nutrient management (76.33%), selection of genuine planting material (71.67%) and pest and disease management (53.12%).

    Hence, it is recommended that, while organizing the demonstrations and training programmes for mandarin growers, the major emphasis should be given on drainage management, proper selection of soil, nutrient management, selection of genuine planting material and pest and disease management practices by the extension agencies.

34. The study on soybean crop revealed that 50.00 per cent of soybean-growing farmers lacked knowledge about seed treatment and 43.00 per cent of farmers did not treat their seeds before sowing. Therefore, it is recommended that agricultural extension agencies should organize training programs to highlight the importance of seed treatment.

35. 83.33 percent of the farmers expressed that the annual agricultural exhibition (AGROTECH) organized by Dr. Panjabrao Deshmukh Krishi Vidyapeeth Akola, was highly effective and the organization was satisfactory. Additionally, 75.83 per cent of farmers who visited the exhibition reported an increase in their knowledge. Therefore, it is recommended that the state government may provide independent funding to the four agricultural universities in the state to organize such exhibitions on a regular basis.

36. Farmers reported that the unavailability of biofertilizers and biocontrol products at the local level was a major constraint, resulting in limited use (38.08%). Therefore, it is recommended that Farmer Producer Organizations (FPOs) and extension agencies should arrange for quality biofertilizers and biocontrol products to be made available to the farmers at local level.

37. To protect the income of paddy growers, disrupt the life cycle of pests and diseases affecting paddy and to address challenges in adopting alternative crops for summer paddy, extension agencies should focus on strategic extension planning. Additionally, comprehensive extension programs should be implemented to promote alternative crops having higher monetary returns such as watermelon, tomato, brinjal, sesame, summer groundnut, and green gram.

Agricultural Economics

38. The productivity of Nagpur mandarin under Indo-Israel High density plantation technology was increased by 18.40 ton/ha over traditional method i.e. 218 per cent

more. However, the additional return increased by 258 per cent. Hence, it is recommended that Indo-Israel High density plantation technology should be disseminated on large scale by Government through extension agencies

39. The farmers earned gross economic benefit of Rs. 636 Crores during last seventeen year (2007-08 to 2023-24) from PKV Kranti variety of sorghum released by Dr. PDKV, Akola. Hence, it is recommended that for economic upliftment of farmer, government should provide sufficient fund to the University for further research, extension and development for improved new varieties of sorghum, seed production and mechanization.

40. The benefit-cost ratio of summer vegetables i.e. okra (2.19), brinjal (1.93), tomato (1.86) and chilli (1.79) were estimated more than one along with better technical and economic efficiency. Hence it is recommended that the farmers of Eastern Vidarbha Zone should be motivated through extension agencies for cultivation of these summer vegetables for economic upliftment.

41. In Eastern Vidarbha Zone the benefit-cost ratio of Linseed (1.47) and Mustard (1.41) crops cultivation were more than one. Hence it is recommended that the farmers of Eastern Vidarbha Zone should be motivated for cultivation of Linseed and Mustard through extension agency for economic upliftment.

42. The BEP for Linseed and Mustard were 1067 and 441 kg oil along with percentage margin of safety 22 and 18 per cent respectively. The processing units for both the crops is profitable venture. Hence it is recommended that Government should provide the financial scheme for establishment of such processing unit in Eastern Vidarbha Zone and farmers should be motivated for establishment of processing unit through extension agencies.

43. Due to fruit drop in orange orchards per hectare, the percentage increase in productivity of high adopters of Standard Operating Practices (SoP) over low adopters was 51.14 per cent. Similarly total production losses and economic losses due to fruit drop have been decreased by 49.33 and 21.11 per cent respectively. Hence, it is recommended that, the university recommended Standard Operating Practices (SoP) to avoid fruit drop should be promoted and disseminated regularly through the extension agencies for high adoption.

44. The cropping intensity has increased from 117 to 124 per cent during the period 2023-24 to 2024-25. Similarly, the productivity of gram, safflower and wheat has increased by 1.42 to 12.46 q/ha, 1.88 to 7.75 q/ha and 15.32 to19.34 q/ha, respectively due to farm ponds. Hence, it is recommended that, Government should provide financial support to Government Institutions for establishment of farm ponds along with irrigation systems to enhance the seed production and motivate the farmers for establishing farm ponds through extension agencies

45. In India, to maintain the Equilibrium Price of Onion i.e. Rs. 1958 per quintal (year constant at 2024), the moderate arrival should be 14.07 lakh tons per month. In the month of March and June, Arrival index has been highest; however, price index has

been lowest and vice versa situation was seen in the month of October, which deviates from moderate arrival and equilibrium price.

Therefore, it is recommended that the Onion export should be promoted in the month of March and June and buffer stock should be increased to stabilize the price through open market by NAFED (National Agricultural Cooperative Marketing Federation of India Ltd). However, Onion buffer stock can be released in the month of October. Farmers should be encouraged to construct the On-farm Modern Onion Storage Structures / Onion Storage Centers through Government schemes to control price fluctuation.

46. The arrival and prices of paddy, were negatively correlated at APMC market. However, the storage capacity is only 7 per cent of total production in Gadchiroli district. Hence, it is recommended that, to stabilize the prices of paddy Government needs to take initiative to increase the storage capacity and provide small to medium size godown to the farmers.

3.7. GENETICS AND PLANT BREEDING

Plant Physiology

Year : 2022

1. Two foliar sprays of 40 ppm Chitosan (40 mg Chitosan dissolved in 8.5 ml 0.1 N HCl or 20-25 ml domestic acid and prepare solution in 1 litre water) at 25 and 40 DAS are recommended for obtaining higher yields and maximum economic returns in Green gram.

Agricultural Botany

Year : 2024

2. To prepare good quality herbal tea from butea (*Palas*) monosperma flower, it is recommended to use 60% dried flowers with 20% Artesimia (*Dawana*), 10% fennel seed, 10% Mulethi (*Jeshthamadh*) or use 60% dried flowers with 20% fenugreek seed, 5% cinnamon, 10% Mulethi (*Jeshthamadh*) and 5% cardamom.

3. It is recommended to use 50 percent grape pulp or pomegranate juice to prepare value added fermented beverage from butea (Palas) flower.

Year : 2025

4. Dr. PDKV developed technology for micro propagation of Spine gourd *var*. Akra Bharat *(Memordica cochinchinesis* L.*)*, a nodal segment of 2 cm size sterilized with 5% sodium hypochlorite 40 min = 0.2% Carbendazim, followed by 1.25 mg/L cefotaxime each for 60 min and explants inoculation on MS basic media (PH=5.8) supplemented each with 2 mg/L BAP + L-GA for it6s efficient shoot multiplication and MS + 1 mg/L NAA for high root induction, followed by hardening for 45 days with cocopeat : soil : FYM (1:2:1) proportion is recommended.

5. *Bacillus thuringiensis* isolates PDKV-Bt-SA-22, PDKV-Bt-SAk-12 and PDKV-Bt-SUd-1 are recommended for the submission in useful microorganism group and their further utilization in research.

6. Mustard genotypes ACN 226 and ACN 237 (PDKV Kartik) are terminal heat tolerant genotypes, therefore genotype ACN 226 and ACN 237 (PDKV Kartik) are proposed for registration.

3.8. ORGANIC FARMING

Year : 2023

1. In organic farming intercrop rotation of Blackgram + Finger millet (2:1) or Blackgram + Barnyard millet (2:1) in kharif season followed by Chickpea + Ajwain (2:1) or Chickpea + coriander (2:1) in rabi season for getting higher sustainable yield, monetary returns and soil health improvement. For nutrient management, seed treatment with bio-fertilizers, application of 2 tonne vermicompost and 300 kg phosphorous rich organic manure per hectare for both seasons and for pest management, spraying of botanicals (Dashparni ark 250 ml. in 10 lit. of water and 5% NSE) is recommended.

2. In organic Rice, seed treatment with *Azospirillum*, PSB and Trichoderma in nursery and application of vermicompost 5 t ha^{-1} + phosphorous rich organic manure (PROM) 200 kg ha^{-1} in soil before puddling of Sunhemp green manuring for getting sustainable yield, monetary returns and improving soil fertility and for pest management, use Trichocard @ 5 cards/ha 4 times and spraying with 5% NSKE or Dashparni Ark 250 ml/10 liter water and bio-pesticide, *Verticillium lecanii and Metarhizium anisopliae* @ 40 ml/10 liter water is recommended.

University Released Varieties & Farm Machineries

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