The Scenario of Pulses In Rajasthan

Scope and Opportunity

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- S. K. Jain
- S. S. Rajput
- Manish Kumar
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ICAR - AICRP on Kharif Pulses
Rajasthan Agricultural Research Institute
(S.K.N Agriculture University, Jobner)
Durgapura, Jaipur (Rajasthan) - 302018

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FOREWORD

It gives me immense pleasure to present this comprehensive volume, ***"The Scenario of Pulses in Rajasthan: Scope and Opportunity",*** This scholarly work offers an insightful analysis of pulse cultivation across the state and situates Rajasthan's contribution within the broader national context. Pulses, often referred to as the cornerstone of nutritional security in India, hold an essential place in our rainfed farming systems and dietary patterns. With shifting climatic patterns and growing concerns about sustainability, the relevance of pulse crops has only intensified.

Rajasthan, with its vast arid and semi-arid agroecology, plays a pivotal role in the cultivation of pulses, especially moth bean, cluster bean and mungbean. Despite facing climatic adversities, our state continues to demonstrate resilience and innovation in pulse production. It is particularly encouraging to note that Rajasthan alone contributes nearly the entire moth bean production of the country and ranks among the top states in chickpea and mungbean cultivation.

This book not only documents the current scenario but also highlights the tremendous scope for improvement in varietal development, agronomic practices and pest and disease management. The strategic role of research and coordinated efforts, such as those under the All India Coordinated Research Projects (AICRPs), has been crucial. With the development of nearly 100 pulse varieties across key centers in Rajasthan, we are well positioned to meet the challenges of food security, soil health restoration and farmer profitability.

The detailed chapters on breeder seed production, crop protection and varietal improvements underscore the importance of an integrated approach. As natural resources dwindle and rainfall patterns become increasingly erratic, promoting pulse cultivation is no longer just an option, it is a necessity. Pulses not only enrich our soils through biological nitrogen fixation but also offer a sustainable alternative to water and input intensive crops.

I congratulate the authors and contributors for their exhaustive efforts in compiling this valuable resource. I am confident that this book will serve as a critical reference for researchers, policymakers, extension workers and farmers alike. It will also inspire further research and innovation in enhancing the productivity and profitability of pulse crops in Rajasthan and beyond.

Let us work together to harness the full potential of pulses for a sustainable agricultural future.

(Balraj Singh)

Dr. Shailesh Marker
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MESSAGE

I am delighted to announce the release of the bulletin titled ***"The Scenario of Pulses in Rajasthan: Scope and Opportunity",*** compiled under the All India Coordinated Project on Kharif Pulses by Sri Karan Narendra Agriculture University, Jobner. This well-researched document provides a comprehensive overview of the pulse sector in Rajasthan, highlighting current trends, varietal advancements, seed systems, and innovative technologies transforming pulse cultivation across the state.

Pulses are a vital source of nutrition for both humans and livestock and play a pivotal role in sustainable agriculture. With over 5.8 million hectares under pulse cultivation, Rajasthan is a major contributor to India's pulse output—2.09 million hectares of Rabi pulses yield 2.59 million tonnes, while 3.71 million hectares of Kharif pulses produce 2.17 million tonnes. Guar is cultivated on 2.98 million hectares, adding 1.93 million tonnes to the state's production.

Beyond nutrition, pulses contribute significantly to sustainable farming. Their nitrogen-fixing ability improves soil fertility, making them ideal for dry and rainfed regions. Requiring minimal external inputs, pulses are well suited for low-resource areas. They also support crop diversification and intensification—key strategies in the face of climate change. With a low water and carbon footprint, pulses play a crucial role in conserving soil and mitigating environmental challenges.

Our agricultural research institutions have developed high-performing, region-specific Rabi and Kharif pulse varieties. Supported by a strong seed production and distribution network, these efforts ensure timely access to quality seeds, boosting productivity. Advances in pest and nutrient management, efficient water use, and improved sowing techniques are further enhancing pulse yields across Rajasthan's varied agro-climatic zones.

This bulletin reflects the dedication and scientific excellence of the Pulses Research Group at Sri Karan Narendra Agriculture University. I commend the editorial team for compiling this valuable resource, which will benefit farmers, researchers, extension workers, and policymakers alike. I hope it inspires further innovation, collaboration, and sustainable growth, reinforcing Rajasthan's leadership in India's pulse sector.

(Shailesh Marker)

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MESSAGE

It gives me great satisfaction to announce the publication of the bulletin ***"The Scenario of Pulses in Rajasthan: Scope and Opportunity",*** compiled under the All India Coordinated Research Project on Kharif Pulses by Sri Karan Narendra Agriculture University, Jobner. This document offers valuable insights into Rajasthan's pulse sector, covering trends, varietal innovations, seed systems, and advanced farming technologies.

With nearly 5.8 million hectares under pulses, Rajasthan contributes over 4.7 million tonnes annually to India's production—2.09 million hectares of Rabi pulses yield 2.59 million tonnes, while 3.71 million hectares of Kharif pulses produce 2.17 million tonnes. Guar, grown on 2.98 million hectares, adds about 1.93 million tonnes to the state's agricultural output.

Despite challenges like erratic rainfall and poor soils, productivity is improving thanks to climate-resilient varieties and scientific farming. Our research institutions have developed high-performing, region-specific cultivars including RSGD 1155, CSJ 515, GNG 1581 (chickpea); RMG 268, MSJ 118 (mungbean); Karan Guar 1, RGC 1066 (guar); CAZRI Moth 1–6 (moth bean); KU and KM series (urdbean and lentil).

These achievements are backed by an efficient seed distribution system ensuring timely access to quality seeds. Integrated pest and nutrient management, efficient water use, and improved sowing practices have further strengthened pulse cultivation across Rajasthan's agro-climatic zones.

This bulletin reflects the scientific commitment of the Pulses Research Group at our university. I commend the team for producing a valuable resource for researchers, extension workers, policymakers, and farmers.

Congratulations to the editorial team. I hope this publication inspires continued innovation, collaboration, and inclusive growth in Rajasthan's pulse sector.

Best wishes!

(N. K. Gupta)

Dr. Harphool Singh
Director

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MESSAGE

I am pleased to present the bulletin ***"The Scenario of Pulses in Rajasthan: Scope and Opportunity",*** compiled under the All India Coordinated Research Project on Kharif Pulses by Sri Karan Narendra Agriculture University, Jobner. This publication provides a comprehensive overview of the pulse sector in Rajasthan, highlighting current trends, varietal improvements, seed systems and modern farming technologies that are reshaping pulse cultivation in the state.

The release of this bulletin is timely, as pulses are increasingly recognized not just for their nutritional value but also for their vital role in sustainable agriculture. With protein content ranging from 20 to 25 percent, pulses are essential in combating widespread protein deficiency, particularly in urban areas, where 73 percent of the population lacks adequate protein intake. As plant-based proteins, pulses are a key dietary component for vegetarians and vegans. Their ecological benefits such as nitrogen fixation, low water needs and suitability for rainfed farming, make them especially relevant in today's climate-challenged world.

Rajasthan, with over 5.8 million hectares under pulses, stands as a significant contributor to India's pulse production. This progress is driven by region-specific varietal research, quality seed production and scientific adoption at the grassroots level. This bulletin is a reflection of the scientific dedication and collaborative efforts of the Pulses Research Group at our university. I congratulate the editorial team for producing this valuable resource.

With continued research and innovation, I am confident that Rajasthan will further enhance its leadership in pulses, supporting national goals of nutritional security and sustainable rural development.

Dr. Harphool Singh

PREFACE

Pulses have long held a place of critical importance in Indian agriculture, not only as a major dietary protein source for millions but also as key contributors to soil fertility and sustainable farming systems. Among Indian states, Rajasthan stands out for its vast pulse-growing areas, agro-climatic diversity and evolving cultivation practices. With over 5.6 million hectares under pulse crops, Rajasthan plays a vital role in ensuring food and nutritional security for the nation. This bulletin, ***"The Scenario of Pulses in Rajasthan: Scope and Opportunity",*** offers a comprehensive and data-driven exploration of this vital sector.

The publication begins with a broad overview of pulse cultivation in Rajasthan, including its contribution to national production and comparative status with other leading states. Detailed chapters provide crop-specific insights on chickpea, mungbean, mothbean, urdbean, lentil, cowpea and cluster bean, highlighting their performance, potential and relevance within both state and national contexts.

Recognizing the central role of innovation, the book presents a thorough account of varietal improvement efforts across both Kharif and Rabi pulses, focusing on regionally adapted, high-performing cultivars developed by public research institutions. Seed availability remains critical to the success of these advancements; thus, dedicated sections address breeder seed production trends, variety-wise distribution and institutional coordination mechanisms in Rajasthan.

The book also tackles biotic challenges, documenting major diseases, insect pests and plant parasitic nematodes affecting pulse crops, along with recommended integrated management practices. In parallel, it outlines modern crop production techniques tailored to the region's variable agro-ecologies, ensuring that farmers are equipped with practical strategies to enhance productivity sustainably.

Finally, the publication looks ahead, identifying untapped opportunities and strategic directions for expanding the reach and impact of pulse cultivation across Rajasthan. This includes insights into climate-resilient practices, diversification efforts and policy support that can drive the sector's inclusive growth.

We hope this publication will serve as a valuable resource for researchers, agricultural officers, extension personnel, policymakers and farmers. It is a testament to the coordinated efforts of the Pulses Research Group in Rajasthan, and their commitment to advancing pulse agriculture through scientific rigor and field-level impact.

The Editors gratefully acknowledge the valuable contributions of ***CS Damini Singh and Anirudh Singh*** *in the design and graphics of this book.*

(Sumer Singh Punia)
Incharge, AICRP on Kharif Pulses
Sri Karan Narendra Agriculture University, Jobner

The Scenario of Pulses in Rajasthan: Scope and Opportunity

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Unit 1

AN OVERVIEW OF PULSES CULTIVATION IN RAJASTHAN

R.R. Choudhary, S. S. Rajput, Anju K. Khangarot, Manish Kumar, S. L. Kajla & S. S. Punia

1.1 Introduction

Pulses are grown in 170 countries worldwide, with India being the world's largest cultivator (accounting for approximately 38% of the global cultivated area), producer (around 28% of global production), consumer (about 27% of global consumption), and importer (roughly 14%) of pulses (FAOSTAT, FAO 2024). Chickpeas (Bengal gram/gram/chana), pigeon peas (red gram/arhar/tur), green gram (mungbeans), black gram (urad beans/biri/mash), lentils (masur), field peas (peas/matar), cluster beans (guar), kidney beans (rajmash/common beans/snap beans/French beans), moth beans (moth), horse gram (kulthi), lathyrus (khesari/grass peas/chickling vetch/teora) and cowpeas (lobia/barbati/black-eyed peas) are the twelve major and minor pulses cultivated across approximately 27.50 million hectares in India, with a production of 24.24 million tonnes in 2023–24 (DES, MoA& FW). These crops thrive in diverse climatic and soil conditions, typically concentrated in a few states, with the top ten states (Madhya Pradesh, Maharashtra, Rajasthan, Uttar Pradesh, Karnataka, Gujarat, Andhra Pradesh, Jharkhand, Telangana, and Tamil Nadu) contributing about 91.44% of the total production from 88.99% of the total cultivated area.

Chickpeas reign supreme in India's pulse production, contributing about 47.40% of the total output over the past ten years. This dominance is followed by pigeon peas (15.40%), green gram (12.02%), black gram (10.30%), and lentils (5.40%) (DES, MoA& FW). However, despite its large area, Rajasthan ranks third in terms of production, contributing only 15.25% to the total. Madhya Pradesh, with 55.80 lakh hectares under cultivation (19.74% of the total area), is the largest producer, contributing 24.99% of the total production. Maharashtra, with 44.19 lakh hectares under cultivation (15.63% of the total area), is the second-largest producing state, contributing 16.05% to the total production. These top three states collectively account for a substantial portion, nearly 56% of India's pulse production.

1.2 Contribution of Leading States to Total Pulse Production in India

Table 1.1: Status of Pulse Production in Leading States of India (2015-16 to 2024-25)

Major Producing States	Area (Lakh ha)	Production (Lakh tonnes)	Yield (kg/ha)	Contribution (%)		Yield Rank
				Area	Production	
Madhya Pradesh	55.80	58.99	1032	19.74	24.99	2
Maharashtra	44.19	37.89	842	15.63	16.05	6
Rajasthan	56.08	35.99	636	19.84	15.25	8
Uttar Pradesh	23.81	23.65	988	8.42	10.02	4

Karnataka	28.15	18.31	601	9.96	7.76	10
Gujarat	10.75	13.56	1203	3.80	5.74	1
Andhra Pradesh	12.36	10.24	835	4.37	4.34	7
Jharkhand	7.65	7.90	1027	2.71	3.35	3
Telangana	4.94	4.56	933	1.75	1.93	5
Tamil Nadu	7.83	4.79	621	2.77	2.03	9
All India	**282.73**	**236.10**	**833**	-	-	-

Source: Authors' computation, data from DES, MoA&FW, Govt. of India

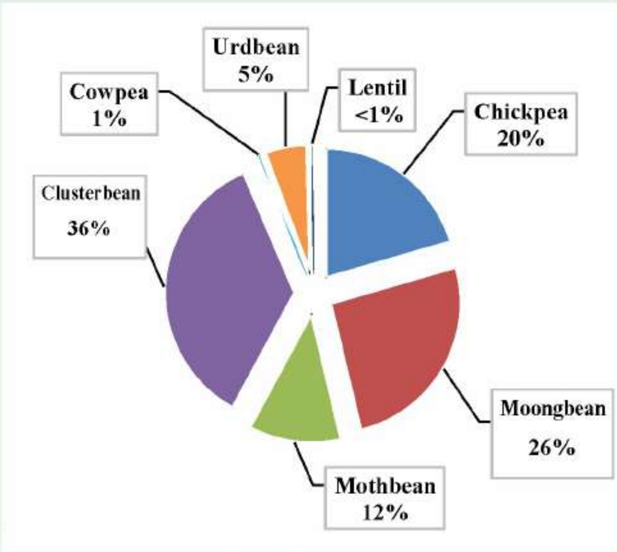
There are significant variations in pulse yields across different states. Gujarat stands out as the most productive state, with a yield of 1,203 kg/ha. In contrast, Karnataka, with a yield of 601 kg/ha, has the lowest productivity among the major pulse-producing states, indicating a yield gap of 602 kg/ha compared to Gujarat **(Table 1.1).**This wide yield gap underscores the potential for improving productivity in states like Karnataka. To bridge these gaps and enhance overall pulse production, it is essential to identify and address region-specific factors that limit productivity.The disparity between high and low performing states highlights the need for focused and localized interventions. Key strategies include the adoption of improved agricultural practices, promotion of high-yielding varieties, enhancement of seed quality and irrigation infrastructure, better soil health and water management, efficient use of fertilizers, and effective pest and disease control. Strengthening extension services and increasing investments in research and development, particularly for climate-resilient varieties and advanced agronomic techniques, will further support efforts to enhance pulse productivity.

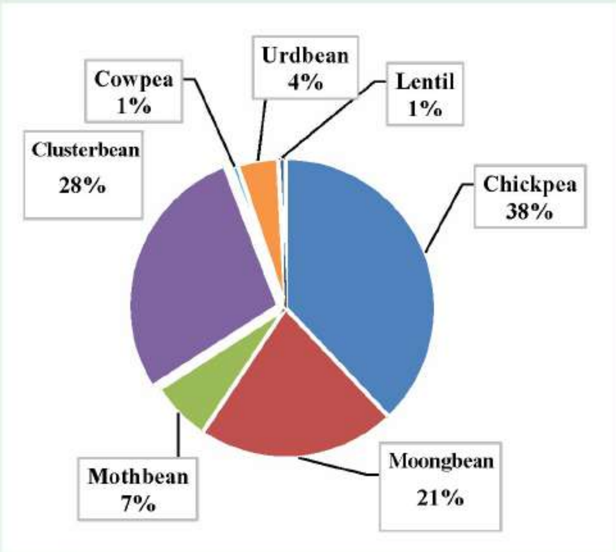
1.3 Contribution of Rajasthan to Pulse Production in India

Rajasthan plays a significant role in India's pulse crop production, particularly in mothbean, clusterbean and mungbean. The state contributes an overwhelming 98.5% of the area and 97.4% of the production of mothbean, making it almost exclusively cultivated in Rajasthan. Similarly, it accounts for 87.97% of the area and 86.12% of the production of clusterbean, and nearly half of the country's mungbean cultivation (48.63% area, 43.10% production). For chickpea, Rajasthan contributes 18.30% of the area and 17.70% of the production, indicating a moderately important role. In contrast, its share in urdbean and lentil cultivation is relatively low, at 10.96% and 2.30% in area, respectively, though lentil shows slightly higher productivity **(Table 1.2).** Overall, Rajasthan is a major hub for arid-zone pulses, and while its area shares are high, there remains potential to improve productivity, especially for crops like mungbean and mothbean.

Table 1.2: Rajasthan's Share in Area and Production of Major Pulses (2015–16 to 2024–25)

Crops	India		Rajasthan		Contribution of Rajasthan	
	Area (L ha)	Production (L ton)	Area (L ha)	Production (L ha)	Area %	Production %
Chickpea	98.58	109.13	18.044	19.313	18.30	17.70
Mungbean	46.65	25.34	22.687	10.922	48.63	43.10
Mothbean	10.367	3.424	10.212	3.335	98.50	97.40
Clusterbean	35.7	16.68	31.406	14.364	87.97	86.12
Urdbean	42.52	25.13	4.661	2.237	10.96	8.90
Lentil	14.94	14.07	0.344	0.396	2.30	2.81





Pie Chart 1.1: Crop Contribution to Total Pulses of Rajasthan

The **pie chart 1.1** illustrates the area share of different pulse crops in Rajasthan. Among these, clusterbean holds the largest share, accounting for 36% of the total pulse cultivation area. It is followed by mungbean, which occupies 26% and chickpea, with a 20% share. Mothbean contributes 12% to the total area, while urdbean has a relatively smaller share of 5%. Cowpea covers only 1% of the area, and lentil occupies less than one percent of the cultivation area. This distribution clearly indicates that clusterbean, mungbean and chickpea are the dominant pulse crops in terms of area under cultivation in Rajasthan.

The pie chart represents the production share of different pulse crops in Rajasthan. Chickpea emerges as the leading contributor, accounting for 38% of the total pulse production, followed by cluster bean at 28% and mungbean at 21%. Moth bean contributes 7%, while urd bean accounts for 4% of the production. Lentil and cowpea each contribute only 1%, indicating minimal production. The data suggest that chickpea not only occupies a significant cultivation area but also leads in productivity. Cluster bean, while having the largest area under cultivation, contributes slightly less to overall production (28%), suggesting relatively lower productivity. On the other hand, mungbean maintains a strong position in both area (26%) and production (21%). This highlights the importance of chickpea and cluster bean in Rajasthan's pulse production landscape, with potential scope for improving the productivity of minor pulses.

1.4 India's Pulse Production Status in the Context of Rajasthan

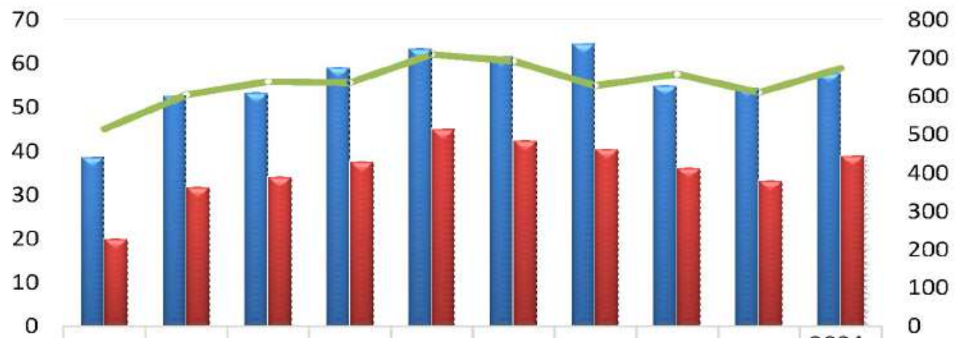
Total Pulses Scenario in India presents a fluctuating trend in pulse cultivation between 2015-16 and 2024-25 **(Figure 1.1).** The area under pulse cultivation initially increased, peaking at 307.3 lakh hectares in 2021-22 before declining to 242.4 lakh hectares by 2024-25. Similarly, production followed a parallel trend, rising to 273 lakh tons in 2021-22, and then slightly dipping to 230.2 lakh tons in 2024-25. However, despite these fluctuations in area and production, productivity steadily improved from 655 kg/ha in 2015-16 to 903 kg/ha in 2024-25, indicating the positive impact of better agronomic practices, improved varieties, and enhanced input management. The slight decline in area and production in recent years suggests the need for continued focus on sustainable agricultural practices, balancing area expansion with yield enhancement, to ensure long-term stability in pulse production.

	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25 (II AE)
Area (L ha)	249.1	294.5	298.1	291.6	279.9	287.8	307.3	289	275.1	242.4
Production (L Ton)	163.2	231.3	254.2	220.8	230.3	254.6	273	260.6	242.5	230.2
Productivity (Kg/ha)	655	786	853	757	823	885	888	902	881	903

Area (L ha) Production (L Ton) Productivity (Kg/ha)

Figure 1.1: Total Pulses Scenario in India

In Rajasthan, data from 2015–16 to 2024–25 (II AE) shows an overall positive trend in pulse cultivation, with fluctuations observed in area, production and productivity (Figure 1.2). The area under pulses expanded from 38.7 lakh hectares in 2015–16 to 58 lakh hectares in 2024–25, peaking at 64.6 lakh hectares in 2021–22. Production increased significantly from 19.9 lakh tons to 39 lakh tons during this period, with the highest output of 45 lakh tons recorded in 2019–20. Productivity also improved steadily, rising from 515 kg/ha in 2015–16 to 673 kg/ha in 2024–25, with the peak productivity of 709 kg/ha also achieved in 2019–20. However, a dip in both production and productivity was noted between 2020–21 and 2023–24, likely due to adverse weather conditions or other region-specific constraints impacting crop performance.



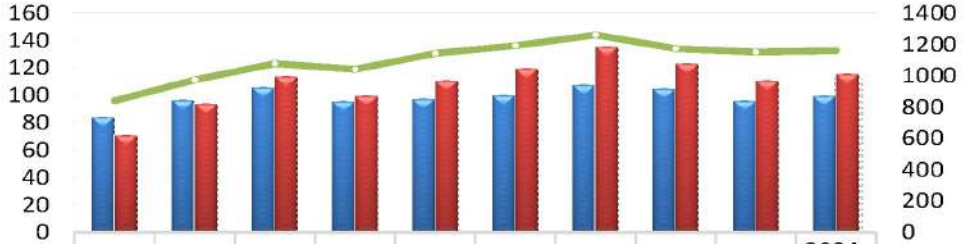
	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25 (II AE)
Area (L ha)	38.7	52.7	53.3	59.1	63.4	61.5	64.6	55	54.6	58
Production (L Ton)	19.9	31.8	34.1	37.6	45	42.5	40.5	36.2	33.3	39
Productivity (Kg/ha)	515	604	639	636	709	692	628	658	610	673

Area (L ha) Production (L Ton) Productivity (Kg/ha)

Figure 1.2 : Total Pulses Scenario in Rajasthan

1.5 Chickpea Scenario in India in the Context of Rajasthan

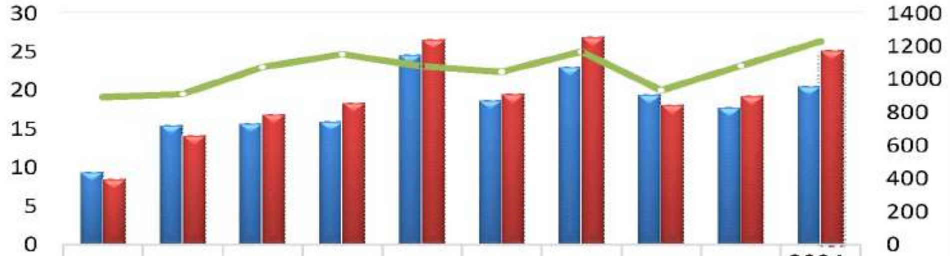
The total area under chickpea cultivation in India is approximately 99.4 lakh hectares, resulting in a total production of about 115.3 lakh tons. The average national yield stands at 1160 kg/ha, reflecting significant potential for productivity improvements across the country (Figure 1.3). Over the years, the increase in chickpea production has largely been driven by an expansion in the cultivated area. Analysis of pulse cultivation data from 2015-16 to 2024-25 (II AE) reveals a positive trend in area, production and productivity until 2021-22, followed by a slight decline in the subsequent years. Specifically, the area under chickpea cultivation grew from 84 lakh hectares in 2015-16 to 107.4 lakh hectares in 2021-22. During the same period, production rose from 70.6 lakh tons to a peak of 135.4 lakh tons. Productivity also improved, increasing from 840 kg/ha in 2015-16 to 1261 kg/ha in 2021-22. However, in the years following 2021-22, both production and productivity showed a downward trend, despite the area remaining relatively stable, indicating potential production constraints and the need for focused interventions to overcome challenges in yield growth.



	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25 (II AE)
Area (L ha)	84	96.3	105.6	95.5	97	100	107.4	104.7	95.9	99.4
Production (L Ton)	70.6	93.8	113.8	99.4	110.8	119.1	135.4	122.7	110.4	115.3
Productivity (Kg/ha)	840	974	1078	1041	1142	1192	1261	1172	1151	1160

Figure 1.3 : Chickpea Scenario in India

In Rajasthan, the data on chickpea cultivation from 2015-16 to 2024-25 (II AE) shows notable growth in area, production and productivity, although with some fluctuations over the years. The area under chickpea cultivation expanded significantly from 9.41 lakh hectares in 2015-16 to 20.47 lakh hectares in 2024-25, reflecting increased efforts to promote pulse cultivation. Production also saw a considerable rise, growing from 8.4 lakh tons in 2015-16 to 25.17 lakh tons in 2024-25, indicating enhanced agricultural practices and improved yield potential. Productivity followed a similar upward trend, increasing from 892 kg/ha to a peak of 1230 kg/ha in 2024-25. However, a dip in productivity occurred in 2022-23, falling to 934 kg/ha, likely due to adverse climatic or agronomic conditions (Figure 1.4). The sharp rise in both area and production in 2019-20 and again in 2024-25 can be attributed to favourable policy support, better seed availability and the adoption of improved agricultural technologies.

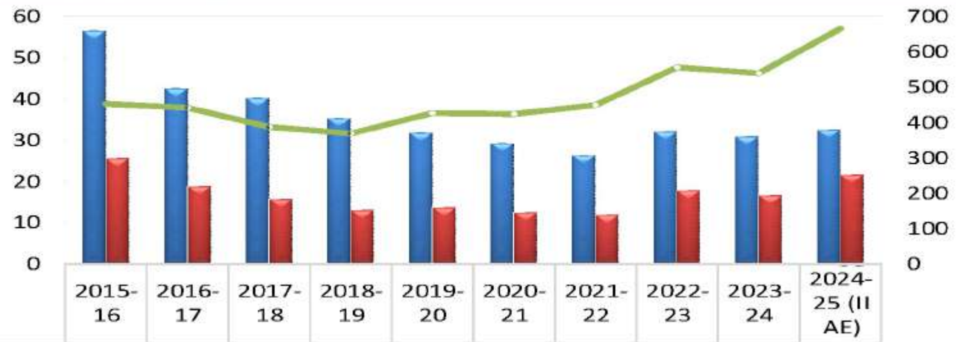


	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25 (II AE)
Area (L ha)	9.41	15.47	15.72	15.96	24.63	18.66	23	19.37	17.75	20.47
Production (L Ton)	8.4	14.09	16.88	18.39	26.58	19.51	26.84	18.08	19.19	25.17
Productivity (Kg/ha)	892	911	1074	1152	1079	1045	1167	934	1081	1230

Figure 1.4 : Chickpea Scenario in Rajasthan

1.6 Cluster Bean Scenario in India in the Context of Rajasthan

In India, from 2015–16 to 2024–25 (II AE), the data reflect a fluctuating but overall improving trend in cluster bean production and productivity despite initial setbacks. The area under cultivation declined from 56.5 lakh hectares in 2015–16 to 26.3 lakh hectares in 2021–22 but gradually rose again to 32.4 lakh hectares in 2024–25. Similarly, production dropped from 25.6 lakh tons in 2015–16 to a low of 11.8 lakh tons in 2021–22, and then increased to 21.6 lakh tons by 2024–25. Notably, productivity remained relatively low until 2020–21, but a consistent improvement was observed thereafter, rising from 424 kg/ha to 666 kg/ha in 2024–25, the highest in the given period (Figure 1.5).

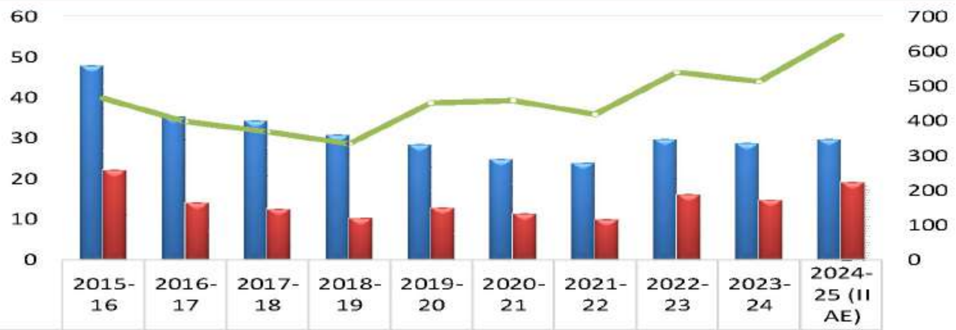


	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25 (II AE)
Area (L ha)	56.5	42.5	40.2	35.2	31.8	29.2	26.3	32.1	30.8	32.4
Production (L Ton)	25.6	18.8	15.6	13	13.6	12.4	11.8	17.8	16.6	21.6
Productivity (Kg/ha)	453	442	388	369	427	424	450	556	539	666

Area (L ha) Production (L Ton) Productivity (Kg/ha)

Figure 1.5: Cluster bean Scenario in India

The data from 2015–16 to 2024–25 (II AE) reveals considerable variability in cluster bean cultivation in Rajasthan. The area under cultivation experienced a sharp decline from 47.86 lakh hectares in 2015–16 to 23.93 lakh hectares in 2021–22, likely due to shifting crop preferences or unfavorable climatic conditions. However, this was followed by a gradual recovery, with the area increasing to 29.82 lakh hectares by 2024–25. Production mirrored this trend, falling from 22.23 lakh tons in 2015–16 to a low of 10.31 lakh tons in 2018–19, before steadily rising to 19.25 lakh tons in 2024–25. Notably, productivity, which had been relatively low and declining until 2018–19, began improving from 2019–20 onwards, reaching a peak of 646 kg/ha in 2024–25 (Figure 1.6). This turnaround suggests that targeted interventions such as the adoption of improved seed varieties, enhanced agronomic practices and better input management have played a key role in boosting yield and stabilizing overall output in the state.



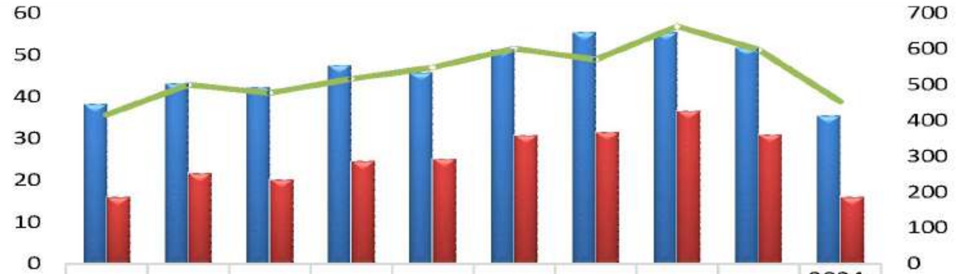
	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25 (II AE)
Area (L ha)	47.86	35.3	34.32	30.87	28.41	24.84	23.93	29.89	28.82	29.82
Production (L Ton)	22.23	14.04	12.65	10.31	12.84	11.36	10.03	16.14	14.79	19.25
Productivity (Kg/ha)	465	398	369	334	452	458	419	540	513	646

Area (L ha) Production (L Ton) Productivity (Kg/ha)

Figure 1.6: Cluster bean Scenario in Rajasthan

1.7 Mungbean Scenario in India in the Context of Rajasthan

Between 2015–16 and 2024–25 (II AE), mungbean cultivation in India exhibited a generally positive trajectory in terms of area, production, and productivity with some recent fluctuations **(Figure 1.7).** The area under cultivation increased from 38.2 lakh hectares in 2015–16 to a peak of 55.5 lakh hectares in 2021–22. However, the 2024–25 data includes only the kharif season, excluding the summer season data for that year. Production rose significantly from 15.9 lakh tonnes in 2015–16 to 36.7 lakh tonnes in 2022–23. Productivity improved steadily from 416 kg/ha in 2015–16 to a high of 663 kg/ha in 2022–23, indicating technological and agronomic advancements. Nevertheless, in 2024–25, productivity declined to 453 kg/ha, likely due to adverse climatic conditions or other factors affecting the kharif season.

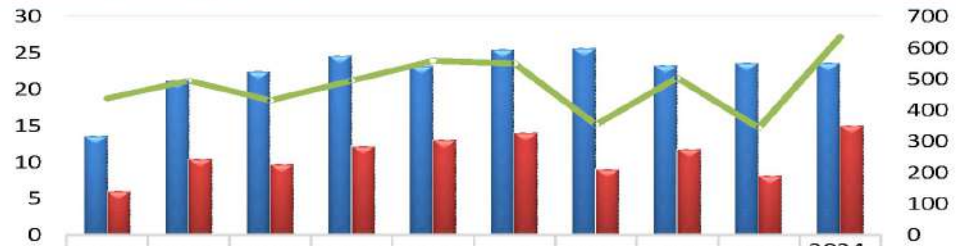


	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25 (II AE)
Area (L ha)	38.2	43.2	42.4	47.5	45.8	51.3	55.5	55.4	51.8	35.4
Production (L Ton)	15.9	21.6	20.2	24.5	25.1	30.8	31.6	36.7	31	16
Productivity (Kg/ha)	416	500	477	516	548	601	570	663	598	453

Area (L ha) Production (L Ton) Productivity (Kg/ha)

Figure 1.7 : Mungbean Scenario in India

The analysis of mungbean cultivation trends from 2015–16 to 2024–25 (II AE) reveals significant fluctuations in area, production, and productivity in Rajasthan (Figure 1.8). The cultivated area increased notably from 13.63 lakh hectares in 2015–16 to a peak of 25.49 lakh hectares in 2020–21, before gradually declining to 23.63 lakh hectares in 2024–25. Production followed a similar trend, rising from 5.96 lakh tonnes in 2015–16 to 14.02 lakh tonnes in 2020–21, then declining to 8.12 lakh tonnes in 2023–24 before rebounding sharply to 15.01 lakh tonnes in 2024–25. Productivity improved from 438 kg/ha in 2015–16 to 559 kg/ha in 2019–20, dipped in the following years (reaching a low of 344 kg/ha in 2023–24), and then surged to 635 kg/ha in 2024–25. This sharp recent increase in productivity, despite a stable area, indicates possible improvements in crop management, seed quality, or favorable climatic conditions, highlighting the potential for enhanced output through technological and agronomic interventions even without expanding the cultivated area.



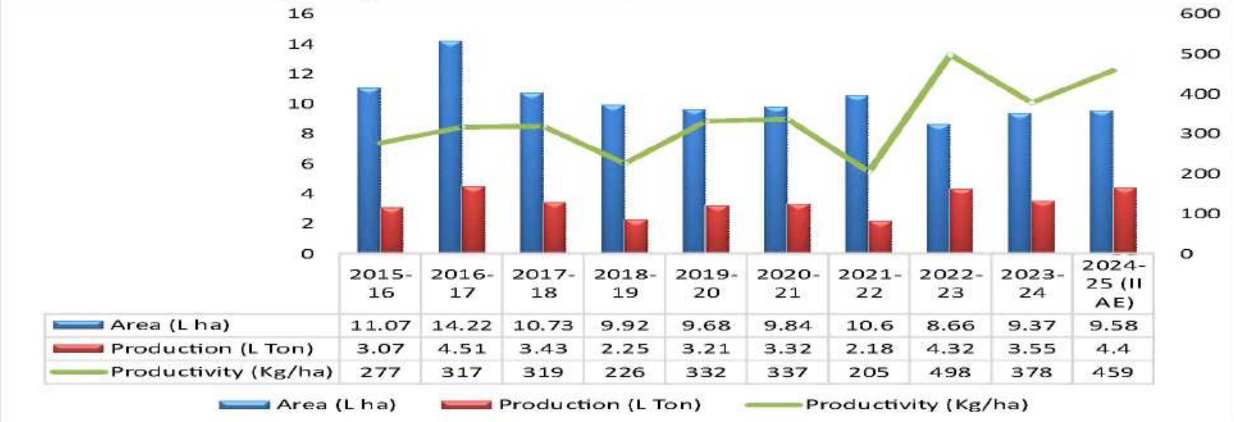
	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25 (II AE)
Area (L ha)	13.63	21.2	22.49	24.65	23.22	25.49	25.6	23.32	23.64	23.63
Production (L Ton)	5.96	10.4	9.71	12.21	12.99	14.02	9.05	11.75	8.12	15.01
Productivity (Kg/ha)	438	495	432	495	559	550	354	504	344	635

Area (L ha) Production (L Ton) Productivity (Kg/ha)

Figure 1.8 : Mungbean Scenario in Rajasthan

1.8 Mothbean Scenario in India in the Context of Rajasthan (2015–16 to 2024–25)

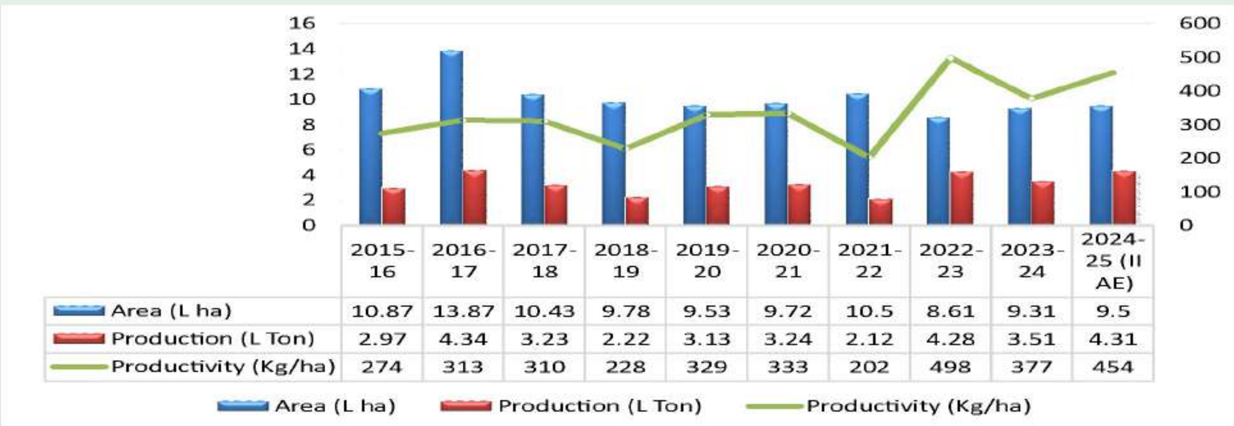
The figure illustrates the trends in area, production, and productivity of mothbean from 2015–16 to 2024–25 (II AE) (Figure 1.9). Over the years, the area under cultivation (lakh hectares) has fluctuated, peaking at 14.22 lakh hectares in 2016–17 before gradually declining and stabilizing around 9–10 lakh hectares in the later years. Production (lakh tonnes) followed a similar pattern, with notable rises in 2016–17 (4.51 lakh tonnes) and 2023–24 (4.32 lakh tonnes). Interestingly, productivity (kg/ha) exhibited considerable variation, reaching a low of 205 kg/ha in 2021–22 and a significant peak of 498 kg/ha in 2022–23. The most recent data for 2024–25 (II AE) shows improved productivity at 459 kg/ha despite a relatively smaller area (9.58 lakh hectares), indicating more efficient cultivation practices or favorable growing conditions. Overall, while the cultivated area has not significantly increased, enhancements in productivity have played a crucial role in boosting total production in recent years.



	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25 (II AE)
Area (L ha)	11.07	14.22	10.73	9.92	9.68	9.84	10.6	8.66	9.37	9.58
Production (L Ton)	3.07	4.51	3.43	2.25	3.21	3.32	2.18	4.32	3.55	4.4
Productivity (Kg/ha)	277	317	319	226	332	337	205	498	378	459

Figure 1.9 : Mothbean Scenario in India

In Rajasthan, the figure presents the area, production and productivity of mothbean from 2015–16 to 2024–25 (II AE) (Figure 1.10). Rajasthan accounts for around 98% of India's total mothbean area and production. The area under cultivation has shown moderate fluctuations, peaking at 13.87 lakh hectares in 2016–17 before dipping to a low of 8.61 lakh hectares in 2022–23, then slightly increasing to 9.5 lakh hectares in the latest year. Production followed a similar trend, with significant rises in 2016–17 (4.34 lakh tonnes) and again in 2022–23 (4.28 lakh tonnes), indicating improved yield potential during those years. Productivity, represented in kg/ha, varied more noticeably, dropping to a low of 229 kg/ha in 2018–19 and surging to a high of 498 kg/ha in 2022–23. The year 2024–25 (II AE) maintains a high productivity of 454 kg/ha despite a relatively moderate area, suggesting improved efficiency or favorable agronomic conditions.

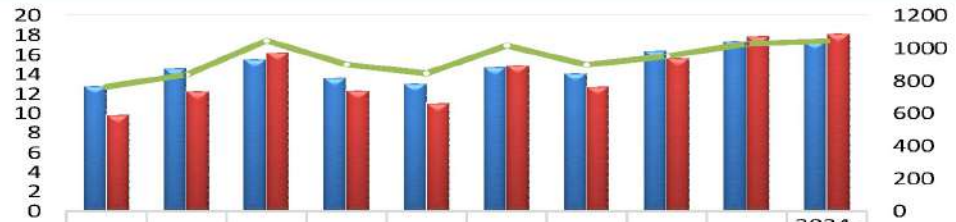


	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25 (II AE)
Area (L ha)	10.87	13.87	10.43	9.78	9.53	9.72	10.5	8.61	9.31	9.5
Production (L Ton)	2.97	4.34	3.23	2.22	3.13	3.24	2.12	4.28	3.51	4.31
Productivity (Kg/ha)	274	313	310	228	329	333	202	498	377	454

Figure 1.10 : Mothbean Scenario in Rajasthan

1.9 Lentil Scenario in India in the Context of Rajasthan (2015–16 to 2024–25)

The figure (Figure 1.11) depicts the area, production and productivity of lentil from 2015–16 to 2024–25 (II AE) in India, showing a generally upward trend across all parameters. The area under cultivation increased from 12.8 lakh hectares in 2015–16 to a peak of 17.4 lakh hectares in 2023–24, with a slight dip to 17.3 lakh hectares in the latest year. Production followed a stronger growth trajectory, rising sharply from 9.8 lakh tonnes in 2015–16 to 18.1 lakh tonnes in 2024–25 (II AE), reflecting increased efficiency and output. Productivity (kg/ha) improved consistently, increasing from 765 kg/ha in 2015–16 to an impressive 1,045 kg/ha in 2024–25, with a notable peak of 1,047 kg/ha in 2017–18. The data highlights significant improvements in crop yield and overall production, supported by both expanded cultivation area and better productivity.



	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25 (II AE)
Area (L ha)	12.8	14.6	15.5	13.6	13	14.7	14.1	16.4	17.4	17.3
Production (L Ton)	9.8	12.2	16.2	12.3	11	14.9	12.7	15.6	17.9	18.1
Productivity (Kg/ha)	765	838	1047	901	847	1017	899	952	1028	1045

Area (L ha) Production (L Ton) Productivity (Kg/ha)

Figure 1.11 : Lentil Scenario in India

The figure (Figure 1.12) illustrates the trends in area, production, and productivity of lentil from 2015–16 to 2024–25 (II AE) in Rajasthan, highlighting significant variations over the years. The cultivated area dropped sharply after 2016–17, falling from around 0.75 lakh hectares to as low as 0.17 lakh hectares in 2019–20, before showing modest recovery and reaching 0.3 lakh hectares in the latest year. Production followed a similar trend, peaking in 2016–17 (0.75 lakh tonnes) before declining and fluctuating in tandem with area. Despite these fluctuations, productivity (kg/ha) steadily increased from 859 kg/ha in 2015–16 to a remarkable 1,560 kg/ha in 2024–25. The consistent rise in productivity, even during periods of reduced area and production, suggests significant improvements in crop management practices, input efficiency, and varietal development. This trend reflects a shift toward more intensive and efficient farming, with higher outputs being achieved from smaller land areas, demonstrating resilience and technological progress in Rajasthan's agricultural system.

	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25 (II AE)
Area (L ha)	0.74	0.75	0.31	0.19	0.17	0.35	0.16	0.2	0.27	0.3
Production (L Ton)	0.63	0.75	0.33	0.23	0.23	0.48	0.22	0.28	0.34	0.47
Productivity (Kg/ha)	859	1003	1074	1164	1375	1347	1326	1375	1254	1560

Area (L ha) Production (L Ton) Productivity (Kg/ha)

Figure 1.12 : Lentil Scenario in Rajasthan

1.10 Urdbean Scenario in India in the Context of Rajasthan (2015–16 to 2024–25)

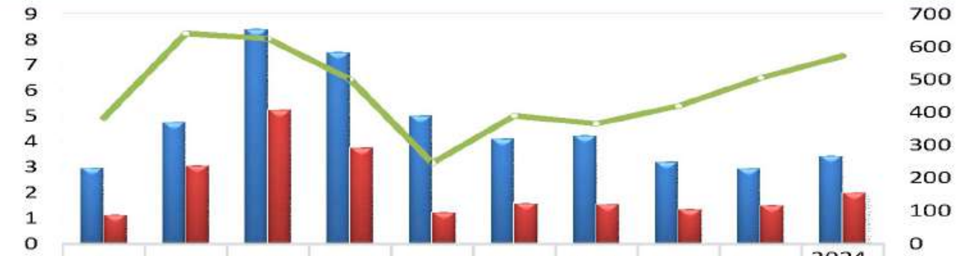
The data from 2015–16 to 2024–25 (II AE) reveals fluctuating trends in the area, production, and productivity of urdbean in India. The area under cultivation increased steadily from 36.2 lakh hectares in 2015–16 to a peak of 56 lakh hectares in 2018–19, followed by a consistent decline, reaching 27.1 lakh hectares in 2024–25 (II AE). Similarly, production peaked at 34.9 lakh tonnes in 2017–18 and declined thereafter, dropping to 18 lakh tonnes in 2024–25 (II AE). Despite these reductions in area and production, productivity (kg/ha) showed a generally increasing trend, rising from 537 kg/ha in 2015–16 to 663 kg/ha in 2024–25 (II AE), with a temporary dip in 2018–19 and 2019–20 (Figure 1.13). This suggests that improved crop management practices and possibly better varietal performance have allowed for increased yields per hectare, even as the total cultivated area and overall production declined in recent years.

	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25 (II AE)
Area (L ha)	36.2	44.8	52.8	56	45.3	41.4	46.3	40	35.3	27.1
Production (L Ton)	19.4	28.3	34.9	30.6	20.8	22.3	27.7	26.3	23	18
Productivity (Kg/ha)	537	632	662	546	459	538	599	657	656	663

Area (L ha) Production (L Ton) Productivity (Kg/ha)

Figure 1.13 : Urdbean Scenario in India

In Rajasthan, the data from 2015–16 to 2024–25 (II AE) indicates significant fluctuations in area, production and productivity of urdbean. The area under cultivation rose from 2.98 lakh hectares in 2015–16 to a peak of 8.39 lakh hectares in 2017–18 before declining sharply to 2.95 lakh hectares in 2023–24, followed by a slight recovery to 3.45 lakh hectares in 2024–25 (II AE) (Figure 1.14). Production showed a similar trend, increasing from 1.14 lakh tonnes in 2015–16 to 5.23 lakh tonnes in 2017–18, then falling to 1.49 lakh tonnes in 2023–24, with a projected rise to 1.98 lakh tonnes in 2024–25 (II AE). Productivity saw an initial surge from 384 kg/ha in 2015–16 to 641 kg/ha in 2016–17, remained relatively high until 2018–19, and then dropped significantly to 246 kg/ha in 2019–20. However, it recovered gradually, reaching 572 kg/ha in 2024–25 (II AE). This suggests that despite reduced area and production in recent years, improved management practices and varietal advancements have helped enhance per hectare productivity, showing a promising upward trend towards the end of the period.

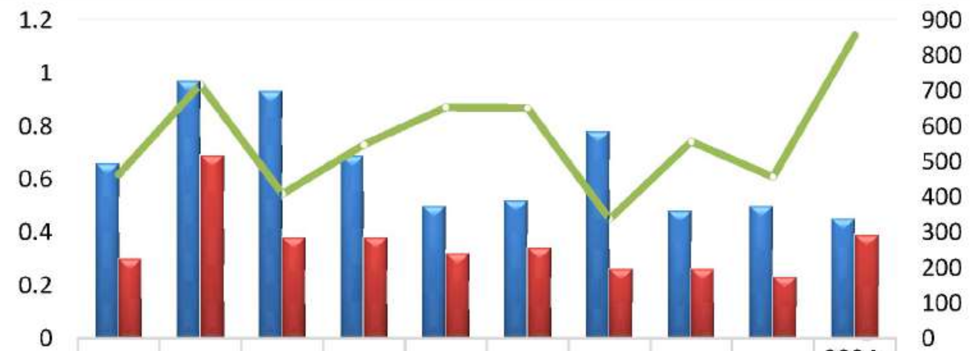


	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25 (II AE)
Area (L ha)	2.98	4.76	8.39	7.5	5.02	4.11	4.24	3.21	2.95	3.45
Production (L Ton)	1.14	3.05	5.23	3.75	1.23	1.6	1.55	1.35	1.49	1.98
Productivity (Kg/ha)	384	641	624	501	246	390	366	420	505	572

Figure 1.14 : Urdbean Scenario in Rajasthan

1.11 Cowpea Scenario in Rajasthan (2015–16 to 2024–25)

The data from 2015–16 to 2024–25 reveals significant fluctuations in cultivated area, production and productivity of cowpea in Rajasthan. Cultivated area peaked in 2016–2017 at 0.97 hectares before declining to around 0.45–0.50 hectares in recent years, while production similarly peaked at 0.69 tons in 2016–2017 before falling and recently recovering to 0.39 tons in 2024–2025(Figure 1.15). Most notably, productivity demonstrates a remarkable improvement in the latest period, reaching an all-time high of 857 kg/ha in 2024–2025, nearly double the previous year's figure, despite using less than half the land area compared to peak years. This inverse relationship between decreasing cultivated area and dramatically increasing productivity suggests a successful shift toward more efficient agricultural practices, potentially through improved farming techniques or crop varieties, achieving higher yields from smaller land areas, and indicating positive developments for sustainable agriculture.



	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25 (II AE)
Area (L ha)	0.66	0.97	0.93	0.69	0.5	0.52	0.78	0.48	0.5	0.45
Production (L Ton)	0.3	0.69	0.38	0.38	0.32	0.34	0.26	0.26	0.23	0.39
Productivity (Kg/ha)	463	718	408	548	653	651	337	556	456	857

Area (L ha)   Production (L Ton)   Productivity (Kg/ha)

Figure 1.15 : Cowpea Scenario in Rajasthan

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1. FAOSTAT, FAO 2024

2. DES. MOA&FW, GOI, New Delhi

3. Rajasthan Agriculture Statistics; Directorate of Economics & Statistics, Govt. of Rajasthan.

Unit 2

VARIETAL IMPROVEMENT IN PULSES

S. S. Rajput, S. K. Jain, Preeti Verma, Khajan Singh, Vijay Prakash, H. R. Mahala & S. S. Punia

Pulses play a vital role in ensuring food and nutritional security, especially in arid and semi-arid regions like Rajasthan. However, productivity levels of pulse crops have remained relatively low due to challenges such as erratic rainfall, poor soil fertility, and susceptibility to pests and diseases. To address these constraints and enhance yield potential, varietal improvement has emerged as a key strategy. Through sustained efforts under national programs like the All India Coordinated Research Projects (AICRPs), significant progress has been made in developing high-yielding, disease-resistant and climate-resilient varieties tailored to local agro-climatic conditions. Rajasthan, being a major pulse-producing state, has contributed substantially to these advancements. This chapter outlines the progress in varietal development for both kharif and rabi pulses, highlighting the achievements of various research centers across the state and emphasizing the critical role of improved varieties in transforming pulse production.

Table 2.1: All India Coordinated Pulse Improvement Projects Operating in Rajasthan

S.No.	Name of AICRP	Name of Centre	Year of Start	Mandate Crops	Number of Varieties Developed
1.	AICRP on Chickpea	ARS, Sri Ganganagar	1988	Chickpea	16
2.	AICRP on Arid Legumes	ARS, Bikaner	1986	Mothbean	11
3.	AICRP on MULLaRP	RARI, Durgapura	2001	Mungbean	6
4.	AICRP on Arid Legumes	RARI, Durgapura	1986	Clusterbean and Cowpea	19
5.	AICRP on Chickpea	RARI, Durgapura	2001	Chickpea	19
6.	AICRP on Chickpea	ARS, Kota	2005	Chickpea	10
7.	AICRP on MULLaRP	ARS, Kota	2005	Lentil, Urdbean & Fieldpea	15
8.	AICRP on Pigeonpea	ARS, Kota	2010	Pigeonpea	-
		Total			***96***

Table 2.2: Major Pulse-Growing Districts of Rajasthan

S. No.	Crop	Occupying zone	Leading districts
Kharif Pulses			
1.	Mungbean	Arid & Semi-arid	Nagaur, Jodhpur, Jalore, Ajmer, Jaipur, Churu, Pali, Tonk, Bikaner, Barmer, Sikar and Jhunjhunu,
2.	Clusterbean	Arid & Semi-arid	Nagaur, Jodhpur, Jalore, Ajmer, Jaipur, Churu, Pali, Bikaner, Barmer, Sikar and Jhunjhunu,
3.	Urdbean	Humid	Bhilwara, Jhalawar, Bundi, Banswara, Dungarpur, Tonk, Udaipur, Chittorgarh and Kota.
4.	Mothbean	Arid	Bikaner, Churu, Barmer, Jodhpur, Nagaur and Hanumangarh
5.	Cowpea	Arid & Semi-arid	Sikar, Jhunjhunu, Nagaur, Jodhpur, Jalore, Ajmer, Jaipur, Churu, Pali, Bikaner and Barmer,
Rabi Pulses			
1.	Chickpea	All the Zones of Rajasthan	Churu, Jaisalmer, Hanumangarh,Bikaner Chittoregarh, Pali, Jaipur, Tonk, Ajmer, Dausa and Kota
2.	Lentil	Humid (Arid & Semi-arid irrigated)	Bundi, Jhalawar, Bharatpur, Bhilwara, Chittorgarh and Pratapgarh.
3.	Vegetable Peas& Fieldpea	Humid & Semi-aridirrigated	Jaipur, Nagaur, Bharatpur, Alwar, Bundi, Jhalawar and Chittorgarh
Summer Pulses			
1.	Mungbean	Irrigated conditions	Banswara, Sriganganagar, Barmer, Tonk, Chittorgarh and Bharatpur

2.1 Varietal Improvement: Kharif Pulses

2.1.1 Rajasthan Agricultural Research Institute, Durgapura

2.1.1.1 Clusterbean (*Cyamopsis tetragonoloba* L.)

1. Karan Guar 15 (RGr 20-15)

Release & notification	:	2024
Agronomic features	:	Rainfed conditions
Area of recommendation	:	All guar -producing regions of India
Planting duration	:	99-104 days
Yield	:	14-15 q/ha
Special features	:	Endosperm content (32.46%), Gum content (29.75%) Viscosity profile (3385cp), Serrated leaves with white flower

2. Karan Guar 14(RGr 18-1)

Release & notification	:	2023
Agronomic features	:	Rainfed conditions
Area of recommendation	:	All guar -producing regions of North India
Planting duration	:	95-96 days
Yield	:	12-13 q/ha
Special features	:	Endosperm (32.26%) and gum content (29.0%) with high viscosity profile (3412 cp). Branched, leaf with serrated margin and bearing pink flower.

3. Karan Guar 1(RGr 12-1)

Release & notification	:	2018
Agronomic features	:	Rainfed conditions
Area of recommendation	:	Rajasthan
Planting duration	:	82-92 days
Yield	:	10-12 q/ha
Special features	:	Medium-height, branched, pink flower, gum content is around 29.5%.

4. Kunjal (RGC 1033)

Release & notification	:	2011
Agronomic features	:	Rainfed conditions
Area of recommendation	:	All guar growing regions of North India
Planting duration	:	95-106 days
Yield	:	15-25 q/ha
Special features	:	Good plant height of 70 to 110 cm and are highly branched. The leaves are dark green non serrated and the flowers are pink. The gum content in this variety ranges from 29.0% to 31.0%.

5. Guar Karan (RGC 1038)

Release & notification	:	2009
Agronomic features	:	Rainfed conditions, Insensitive to photoperiod and is suitable for both summer and monsoon seasons.
Area of recommendation	:	All guar -growing regions of North India
Planting duration	:	100-105 days
Yield	:	11-22 q/ha
Special features	:	This is a medium-duration variety with high branching. The leaves are deeply lobed, and the flowers are pink.The gum content ranges from 28.90% to 32.60%.

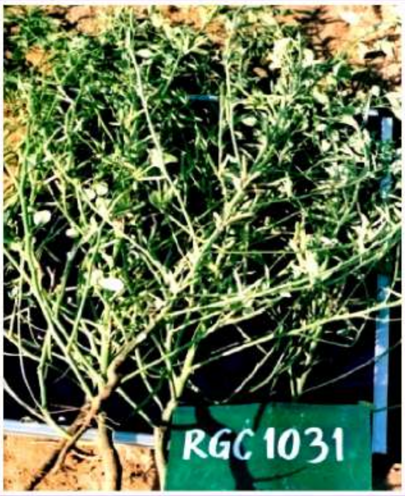
6. Lathi Guar (RGC 1066)

Release & notification	:	2007
Agronomic features	:	Rainfed and irrigated conditions
Area of recommendation	:	Rajasthan
Planting duration	:	100-105 days
Yield	:	10-15 q/ha
Special features	:	Single-stemmed,suitable for both sole cropping and intercropping systems and is especially suitable for harvesting with machines.

7. Guar Uday (RGC 1055)

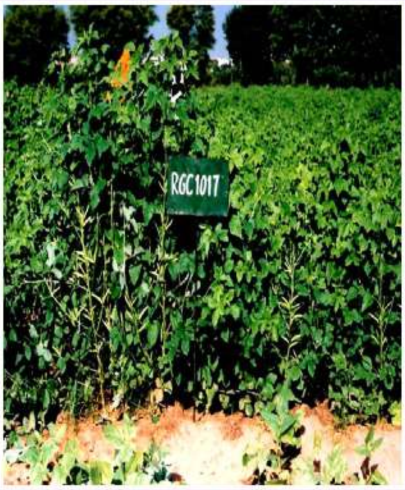
Release & notification	:	2007
Agronomic features	:	Rainfed conditions
Area of recommendation	:	Semi-arid and rainfed areas of Rajasthan
Planting duration	:	95-110 days
Yield	:	20-22 q/ha
Special features	:	The plants of this variety are medium in height (75 to 90 cm), well -branched, with deeply lobed leaves covered with white hairs. The flowers are pink.

8. Guar Kranti (RGC 1031)



Release & notification	:	2005
Agronomic features	:	Rainfed conditions
Area of recommendation	:	All guar -producing regions of North India
Planting duration	:	110-114 days
Yield	:	11-16 q/ha
Special features	:	The plants of this variety are medium in height (75 to 90 cm), well -branched, with deeply lobed leaves covered with white hairs. The flowers are pink.

9. RGC 1017



Release & notification	:	2002
Agronomic features	:	Rainfed conditions
Area of recommendation	:	All guar-producing regions of North India
Planting duration	:	92-99 days
Yield	:	10-14 q/ha
Special features	:	Plants are dwarf (56 - 57 cm), profusely branches and pubescent. Deep serrated leaf margins with light whitish tinge at the surface. It bears pink flowers.

10. Durga Kanchan (M 83): Vegetable Guar

Release & notification	:	2000
Agronomic features	:	Rainfed conditions, Vegetable type
Area of recommendation	:	*Zaid* (Summer) and *kharif* seasons in Rajasthan state
Planting duration	:	80-90 Days
Yield (Green pod)	:	70-75 qt/ha
Special features	:	This variety is indeterminate type, unbranched and tall (100-150 cm.), leaves and pods are glabrous, shining, dark green and with serrated leaf margins.

11. RGC 986

Release & notification	:	2000
Agronomic features	:	Rainfed conditions
Area of recommendation	:	*kharif* seasons in Rajasthan state
Planting duration	:	115-125 days
Yield	:	10-15 qt/ha
Special features	:	Tall (90-130cm.), profusely branched and pubescent. Leaves are dark green, pubescent and with small serration at the margins. The gum content ranges from 28.10-31.40 %.

12. RGC 1002

Release & notification	:	1999
Agronomic features	:	Rainfed conditions
Area of recommendation	:	All guar-producing regions of North India
Planting duration	:	80-90 days
Yield	:	10-13 q/ha
Special features	:	Dwarf (60-90 cm.), and profusely branched. Its leaves deeply serrated and surface pubescent with whitish in colour. This variety has light pink flowers. The gum content ranges from 29-30%.

13. RGC 1003

Release & notification	:	1999
Agronomic features	:	Rainfed conditions
Area of recommendation	:	All guar-producing regions of North India
Planting duration	:	85-92 days
Yield	:	12-15 q/ha
Special features	:	Medium dwarf (51 - 83 cm.), leaves shining dark green. It bears pink flowers. The pods are small in size. The gum content ranges from 29-32%

14. RGC 471

Release & notification	:	1995
Agronomic features	:	Rainfed conditions
Area of recommendation	:	All guar -producing regions of North India
Planting duration	:	110-120 days
Yield	:	12-14 q/ha
Special features	:	Tall (95 -100 cm.), profusely branched, and pubescent and trip innate with serrated leaf margins. Used for for green manuring purpose. The gum content ranges from 29-30%

15. RGC 936

Release & notification	:	1991
Agronomic features	:	Rainfed conditions
Area of recommendation	:	All guar-producing regions of North India
Planting duration	:	80-90 Days
Yield	:	10-12 q/ha
Special features	:	Branched, pubescent and bushy. Leaves are whitish, pubescent and serrated leaf margins. It bears white flowers. The gum content is 28.05%

16. RGC 197

Release & notification	:	1990
Agronomic features	:	Rainfed conditions
Area of recommendation	:	All guar -producing regions of North India
Planting duration	:	100-120 Days
Yield	:	10-12 q/ha
Special features	:	Un-branched, tall (90-120 cm.) and pubescent. Broad leaves with shinning and non-serrated margins of leaves. This variety is suitable for inter cropping and mixed cropping

2.1.1.2 Cowpea (*Vigna unguiculata* L.)

1. Karan Chawla 1(CPD 119)

Release & notification	:	2018
Agronomic features	:	Rainfed conditions
Area of recommendation	:	Rajasthan
Planting duration	:	70 days
Yield	:	6.5-7.0 q/ha
Special features	:	White large - medium boldseed (11.9 g/100 seed) with black brown eye , Preferred by the consumer over bold seed variety . Resistant to moderate resistant against mosaic, necrosis, root rot and CLS.

2. RC 101

Release & notification	:	2001
Agronomic features	:	Rainfed conditions
Area of recommendation	:	Rajasthan
Planting duration	:	65-70 days
Yield	:	6-8 q/ha
Special features	:	Moderate plant height (45 cm) with mature in 65 days. White seed (11.18 g /100 seed weight) Moderately tolerant to disease and pest.

3. RC 19

Release & notification	:	1987
Agronomic features	:	Rainfed conditions
Area of recommendation	:	Rajasthan
Planting duration	:	60 days
Yield	:	7-8 q/ha
Special features	:	Red brown and medium size seed (10.0g /100 seed), Resistant to moderate resistant against necrosis and root rot.

2.1.1.3 Mungbean *(Vigna radiata L.)*

1. RMG 975

Release & notification	:	2016
Agronomic features	:	Rainfed conditions
Area of recommendation	:	Rajasthan
Planting duration	:	68-72 days
Yield	:	10-12 q/ha
Special features	:	Seed rectangular, medium bold and shining green, resistant to moderate resistant against MYMV.

2. MSJ 118

Release & notification	:	2016
Agronomic features	:	Rainfed conditions
Area of recommendation	:	Rajasthan
Planting duration	:	65-70 days
Yield	:	10-12 q/ha
Special features	:	Seed rectangular, medium size and khaki green colour, resistant to moderate resistant against MYMV.

3. RMG 492

Release & notification	:	2003
Agronomic features	:	Rainfed conditions
Area of recommendation	:	Rajasthan
Planting duration	:	65-70 days
Yield	:	9-10 q/ha
Special features	:	Seed rectangular, medium bold size and shining green in colour,100-seed weight 4.1 g, moderately resistant to YMV, and resistant to web blight and CLS on field condition.

4. RMG 344

Release & notification	:	2001
Agronomic features	:	Rainfed conditions
Area of recommendation	:	Rajasthan
Planting duration	:	68-72 days
Yield	:	9-10 q/ha
Special features	:	Seed rectangular, medium bold size and shining green in colour, 100-seed weight 3.6g, moderately resistant to YMV.

5. RMG 268

Release & notification	:	1998
Agronomic features	:	Suitable for normal sowing condition and low rainfall areas of Rajasthan
Area of recommendation	:	Rajasthan
Planting duration	:	64-70 days
Yield	:	8-10 q/ha
Special features	:	Photo-insensitive, resistant to drought and tolerant to web blight. Leaves green with smooth and entire margins. Foliage remains green after maturity

6. RMG 62

Release & notification	:	1991
Agronomic features	:	Suitable for normal sowing condition and low rainfall areas of Rajasthan
Area of recommendation	:	Semi-arid and arid regions of Rajasthan
Planting duration	:	65-70 days
Yield	:	7-8 q/ha
Special features	:	Plants are medium tall and erect having seeds of shinning green colour. It is resistant to drought and web blight and highly responsive to *Rhizobium*.

2.1.2 Varieties developed by ARS, Kota

2.1.2.1 Urdbean (*Vigna Mungo* L.)

1. Pratap Urd 1 (KPU 07-08)

Release & notification	2013
Agronomic features	Rainfed conditions
Area of recommendation	Urdbean growing area of Rajasthan
Planting duration	70-75 days
Yield	10-12 q/ha
Special features	Seed is bold & dull black colored which is preferred by consumers and suitable for rainfed conditions

2. Mukundra Urd 2 (KPU 405)

Release & notification	2018
Agronomic features	Rainfed conditions
Area of recommendation	North Western Plain Zone
Planting duration	68-73 days
Yield	10-13 q/ha
Special features	Seed is bold & dull black colored which is preferred by consumers and suitable for rainfed conditions

3. Kota Urd 3 (KPU 514-65)

Release & notification	2020
Agronomic features	Rainfed conditions
Area of recommendation	Urdbean growing area of Rajasthan
Planting duration	68-72 days
Yield	10-15 q/ha
Special features	Seed is medium in size& dull black colored ,sympodial bearing, resistant to MYMV

4. Kota Urd 4 (KPU 12-1735)

Release & Notification	:	2020
Agronomic features	:	Rainfed conditions
Area of recommendation	:	North Eastern Plain Zone
Planting duration	:	70-75 days
Yield	:	10-13 q/ha
Special features	:	Seed is medium in size& dull black colored, resistant to MYMV& Cercospora leaf spot

5. Kota Urd 5 (KPU 52-87)

Release&Notification	:	2021
Agronomic features	:	Rainfed conditions
Area of recommendation	:	South Zone
Planting duration	:	72-75 days
Yield	:	11-14 q/ha
Special features	:	Semi-spreading, s eed is medium in size & dull black colored, resistant to MYMV& leaf crinkle

6. Kota Urd 6 (KPU 18-1)

Release & Notification	:	2024
Agronomic features	:	Rainfed conditions
Area of recommendation	:	North Western Plain Zone
Planting Duration	:	73-76 days
Yield	:	14-15 q/ha
Special features	:	Semi-spreading, seed is medium in size & dull black colored, resistant to MYMV & leaf crinkle

2.1.3 Varieties Developed by ARS, Bikaner

2.1.3.1 Mothbean (*Vigna aconitifolia* L.)

1. Jadia

Release & notification	:	1980
Agronomic features	:	Rainfed conditions
Area of recommendation	:	All moth growing area of India
Planting duration	:	85-90 days
Seed yield Green fodder yield	:	4.5-5.0 q/ha 12.0 q/ha
Special features	:	Spreading, s eeds are dark brown, medium bold 100-seed wt.2.5-3.5 g)

2. Jawala

Release & notification	:	1985
Agronomic features	:	Rainfed conditions
Area of recommendation	:	All moth growing area of India
Planting Duration	:	80-90 days
Seed yield Green fodder yield	:	5.0-5.5 q/ha 17-18 q/ha
Special features	:	Resistant MYMV, Harvest Index 25-28%

3. Maru Moth

Release & notification	:	1989
Agronomic features	:	Rainfed conditions
Area of recommendation	:	All moth growing area of Rajasthan
Planting duration	:	80-85 days
Seed yield	:	5.0-5.5 q/ha
Special features	:	Semi-spreading type, less affected by Cercospora leaf spot, suited for inter cropping

4. IPCMO 800

Release & notification	:	1989
Agronomic features	:	Rainfed conditions
Area of recommendation	:	Western Rajasthan
Planting duration	:	80-85 days
Seed yield	:	4.5-5.0 q/ha
Special features	:	Spreading type, leaves are broad and deeply lobed, seed protein 22-24%, HI 20-25%

5. IPCMO 912

Release & notification	:	1994
Agronomic features	:	Rainfed conditions
Area of recommendation	:	Semi-arid region of Rajasthan
Planting duration	:	75-85 days
Seed yield	:	4.0-5.0 q/ha
Special features	:	Showing field tolerance to MYMV and Bacterial blight, narrow leaflets

6. RMO 40

Release & notification	:	1994
Agronomic features	:	Rainfed conditions
Area of recommendation	:	Arid conditions of the India
Planting duration	:	62-65 days
Seed yield	:	6.0-8.0 q/ha
Special features	:	Erect & short stature synchronous growth habit, can escape drought and YMV infection, suited for close spacing, HI 30-32 %

7. RMO 257

Release & notification	:	1997
Agronomic features	:	Rainfed conditions
Area of recommendation	:	Arid and semi-arid conditions of the India
Planting duration	:	64-66 days
Seed yield Green fodder yield	:	6.0-8.0 q/ha 18-20 q/ha
Special features	:	Semi-erect growth habit, bears 3-6 branches/plant, less YMV infection

8. RMO 225 (Maru Vardan)

Release & notification	:	1999
Agronomic features	:	Rainfed conditions
Area of recommendation	:	Arid and semi-arid conditions of the India
Planting duration	:	62-65 days
Seed yield Green fodder yield	:	6.0-7.0 q/ha 17-20 q/ha
Special features	:	Semi-erect growth habit, grain light brown, escapes drought and YMV infection

9. RMO 435

Release & notification	:	2001
Agronomic features	:	Rainfed conditions
Area of recommendation	:	Dry and low rainfall zones of the India
Planting duration	:	64-67 days
Seed yield	:	6.0-7.0 q/ha
Special features	:	Semi-spreading growth habit, escapes drought, resistance to YMV, leaves are broad with dark green color

10. RMO 423

Release & notification	:	2002
Agronomic features	:	Rainfed conditions
Area of recommendation	:	All moth growing areas of Rajasthan
Planting duration	:	67-70 days
Seed yield	:	6.0-7.0 q/ha
Special features	:	Suitable for both seed and fodder purpose, resistant to YMV

11. RMO 2004

Release & notification	:	2004
Agronomic Features	:	Rainfed conditions
Area of recommendation	:	All moth growing areas of Rajasthan
Planting Duration	:	65-70 days
Seed yield	:	6.0-8.0 q/ha
Special features	:	Suitable for both seed and fodder purpose, resistant to YMV, high protein content

12. RMO 2251 (Marudhar)

Release & notification	:	2004
Agronomic features	:	Rainfed conditions
Area of recommendation	:	All moth growing areas of Rajasthan
Planting duration	:	63-67 days
Seed yield	:	6.0-6.5 q/ha
Special features	:	Erect with 3 to 5 branches, suitable for mixed cropping, fodder remain green up to maturity

2.1.4 Varieties developed by CAZRI, Jodhpur

2.1.4.1 Mothbean (*Vigna aconitifolia* L.)

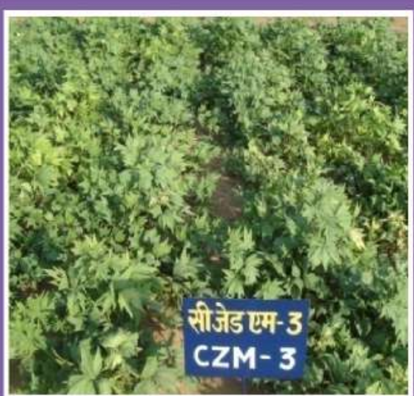
1. CAZRI Moth 1

Release & notification	:	1999
Agronomic features	:	Rainfed conditions
Area of recommendation	:	Rajasthan
Planting duration	:	72-75 days
Seed yield	:	5.0-6.5 q/ha
Special features	:	Semi erect type, profuse bearing, seed protein 25-26 %, showing field resistance to YMV

2. CAZRI Moth 2

Release & notification	:	2003
Agronomic features	:	Rainfed conditions
Area of recommendation	:	Rajasthan, Gujrat, Haryana and Maharashtra
Planting duration	:	72-76 days
Seed yield	:	5.0-7.0 q/ha
Special features	:	Semi erect type, first variety from hybridization, dark green in color

3. CAZRI Moth 3



Release & notification	:	2005
Agronomic features	:	Rainfed conditions
Area of recommendation	:	Rajasthan, Gujrat, Haryana and Maharastra
Planting duration	:	72-75 days
Seed yield	:	5.0-6.5 q/ha
Special features	:	Erect and synchronized growth, escape YMV

4. CAZRI Moth 4 (CZMO 18-2)

Release & Notification	:	2024
Agronomic features	:	Rainfed conditions
Area of recommendation	:	All mothbean growing area of country
Planting duration	:	73-83 days
Seed yield	:	5.0-8.0 q/ha
Special features	:	Shiny brown attractive grain color, shown resistance reaction against foliar and root diseases of moth bean, dark green foliage till maturity, adapted to terminal drought conditions.

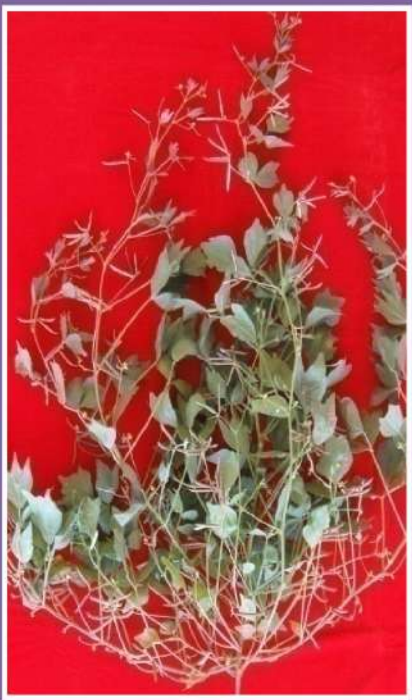
5. CAZRI Moth 5 (CZMO 18-5)

Release & Notification	:	2024
Agronomic features	:	Rainfed conditions
Area of recommendation	:	All mothbean growing area of country
Planting Duration	:	65-70 days
Seed yield	:	6.0-8.0 q/ha
Special features	:	Long peduncle and semi spreading growth habit Shiny brown attractive grain color, resistance reaction against foliar and root diseases of moth, dark green foliage till maturity, Light green foliage till maturity

6. CAZRI Moth 6 (CZMO 18-3)

Release & Notification	:	2025
Agronomic features	:	Rainfed conditions
Area of recommendation	:	All mothbean growing area of country
Planting duration	:	74-76 days
Seed yield	:	6.0-8.0 q/ha
Special features	:	Shiny brown attractive grain color, resistance reaction against foliar and root diseases of moth, dark green foliage till maturity, adapted to terminal drought conditions.

7. CAZRI Moth 7 (CZMO 18-4)



Release & Notification	:	2025
Agronomic features	:	Rainfed conditions
Area of recommendation	:	All mothbean growing area of country
Planting duration	:	75-77 days
Seed yield	:	6.0-8.0 q/ha
Special features	:	Long peduncle and semi spreading growth habit Shiny brown attractive grain color, resistance reaction against foliar and root diseases of moth, dark green foliage till maturity, adapted to terminal drought conditions.

2.2 Varietal Improvement: Rabi Pulses

2.2.1 Varieties developed by RARI, Durgapura

2.2.1.1 Chickpea (*Cicer arietinum*)

1. Karan Chana 20 (RSGD 1155)

Release & notification	:	2025
Agronomic features	:	Late sown conditions
Area ofrecommendation	:	NEPZ
Planting duration	:	116 days
Yield	:	15-20 q/ha
Special features	:	Suitable for late sown conditions, resistant to wilt, dry root rot, and stunt disease, Protein content (19.7%).

2. Karan Kabuli 4 (CSJK 174)

Release & notification	:	2021
Agronomic features	:	Timely sown conditions
Area ofrecommendation	:	South Zone of India
Planting duration	:	100 days
Yield	:	15-20 q/ha
Specialfeatures	:	Bold seeded, resistant against wilt, dry root rot and Stunt disease.

3. Aman (CSJ 515)

Release & notification	:	2016
Agronomic features	:	Timely sown and Rainfed conditions
Area ofrecommendation	:	North Western Plain Zone of India
Planting duration	:	125-130 days
Yield	:	20-25 q/ha
Special features	:	More podding, Minimum D.S.I. (0.68), resistant towilt, BGM & dry root rot. Suitable for mechanical harvesting.

4. Anand (CSJK 21)

Release & notification	:	2013
Agronomic features	:	Timely sown conditions
Area of recommendation	:	Rajasthan
Planting duration	:	130 days
Yield	:	10-12 q/ha
Special features	:	Extra-large Kabuli (56-62gm) Single podded, high yielding, suitable for export

5. Anjali (CSJK 6)

Release & notification	:	2013
Agronomic features	:	Timely sown conditions
Area of recommendation	:	North Western Plain Zone of India
Planting duration	:	130 Days
Yield	:	15-20 q/ha
Special features	:	Bold seeded (30-34 g /100 seed), resistant to wilt and tolerant to BGM and Stunt.

6. Abhilasha (RSG 974)

Release & notification	:	2012
Agronomic features	:	Timely and late sown areas, suitable for rainfed conditions
Area of recommendation	:	Rajasthan
Planting duration	:	130 days
Yield	:	20-25 q/ha
Special features	:	Single podded with high yielding, resistant to wilt and tolerant to BGM and Stunt. Drought tolerant

7. Aparna (RSG 991)

Release & notification	:	2007
Agronomic features	:	Rainfed conditions
Area of recommendation	:	Rajasthan
Planting duration	:	135 days
Yield	:	20-26 q/ha
Special features	:	Green seeded suitable for value addition, moderately resistant to dry root rot, wilt, collar rot and stunt disease. Drought tolerant.

8. Arpan (RSG 896)

Release & notification	:	2007
Agronomic features	:	Rainfed conditions
Area of recommendation	:	Rajasthan for light salinity in water logged area
Planting duration	:	135 days
Yield	:	20-25 q/ha
Special features	:	Suitable for light salinity in water logged area, double podded, moderately resistant to dry root rot and wilt.

9. Aruna (RSG 902)

Release & notification	:	2007
Agronomic Features	:	Late sown, irrigated &Rainfed conditions
Area of recommendation	:	Rajasthan
Planting Duration	:	128-133 days
Yield	:	20-22 q/ha
Special features	:	Double podded, Profuse branching, suitable for all the growing conditions of Rajasthan. Resistant to dry root rot and wilt diseases.

10. Anvita (RSG 931)

Release & notification	2006
Agronomic features	Rainfed conditions
Area of recommendation	NWPZ
Planting duration	130-135 days
Yield	20-25q/ha
Special features	Profuse branching, resistant to dry root rot, wilt disease , collar rot, stunt disease and less incidence of pod borer

11. Abha (RSG 973)

Release & notification	2006
Agronomic features	Rainfed conditions
Area of recommendation	Rajasthan
Planting duration	130-135 days
Yield	15-20 q/ha
Special features	Drought tolerant having high yield, released for rainfed conditions of Rajasthan. It had good resistance level for dry root rot, wilt & nematodes.

12. Abhar (RSG 807)

Release & notification	2006
Agronomic features	Rainfed conditions
Area of recommendation	Rajasthan
Planting duration	125-130 Days
Yield	20-25 q/ha
Special features	Bold seeded, less damage by pod borer. Resistant to dry root rot, wilt, BGM & Colar rot, Lush green leaves, Profuse branching.

13. Aadhar (RSG 963)

Release & notification	:	2005
Agronomic features	:	Late sown, normal sown and rainfed conditions
Area of recommendation	:	NWPZ
Planting duration	:	125-130 days
Yield	:	18-20q/ha
Special features	:	Pigmentation over stem, resistant to wilt, dry root rot, BGM and collar rot.

14. Asha (RSG 945)

Release & notification	:	2005
Agronomic features	:	Late sown, Irrigated and rainfed conditions
Area of recommendation	:	NWPZ
Planting duration	:	135-140 days
Yield	:	20-25 q/ha
Special features	:	High yield, Profuse branching, Suitable for late sown, resistant to dry root rot and wilt disease

15. Arpita (RSG895)

Release & notification	:	2005
Agronomic features	:	Late sown, Irrigated and Rainfed conditions
Area of recommendation	:	NWPZ
Planting duration	:	135 days
Yield	:	15-20 q/ha
Special features	:	High yield, White flower double pods. It is suitable for nipping and grazing.

16. Asar (RSGK 6)

Release & notification	:	2003
Agronomic features	:	Rainfed conditions
Area of recommendation	:	Rajasthan, Madhya Pradesh
Planting duration	:	135 days
Yield	:	15-20q/ha
Special features	:	Bold seeded kabuli gram variety having high yield, moderately resistant to dry root rot and wilt.

17. Akash (CSJD 884)

Release & notification	:	2003
Agronomic features	:	Rainfed conditions
Area of Recommendation	:	Rajasthan
Planting duration	:	124-139 days
Yield	:	15-20q/ha
Special features	:	Double podded, Profuse branching, Semi-erect plant type, Resistant to lodging, Suitable for rainfed condition, Resistant to dry root rot & wilt

18. Anubhav (RSG 888)

Release & notification	:	2002
Agronomic features	:	Rainfed conditions
Area of recommendation	:	Punjab, Haryana, Delhi, Rajasthan, Uttarakhand, West U.P., H.P.and J&K
Planting duration	:	140 Days
Yield	:	15-20q/ha
Special features	:	Drought tolerant, double podded resistant to DRR & Wilt Suitable for rainfed conditions

2.2.2 Varieties developed by ARS, Sri Ganganagar

2.2.2.1 Chickpea (*Cicer arietinum* L.)

1. Moomal(GNG 2461)

Release & notification	:	2023
Agronomic features	:	Rainfed conditions
Area of recommendation	:	NWPZ
Planting duration	:	140 days
Yield	:	21-22q/ha
Special features	:	Attractive brown colour seed, Bold seed (24.5 gm/ 100 seeds), tolerance against Wilt, Ascochyta Blight, Collar Rot, DRR, BGM and Stunt, Good level of protein (20.12 %).

2. Keshav(GNG 2261)

Release & notification	:	2021
Agronomic features	:	Late Sown Irrigated conditions
Area of recommendation	:	NWPZ
Planting duration	:	135-140 days
Yield	:	23-24 q/ha
Special features	:	Attractive seed size (15.0 gm/ 100 seeds), tolerance against Fusarium wilt and Root rot, good level of protein 21.28 %

3. Purva (GNG 2299)

Release & notification	:	2019
Agronomic features	:	Late Sown Irrigated conditions
Area of recommendation	:	NEPZ (Uttar Pradesh, West Bengal, Bihar, Assam, and Jharkhand)
Planting duration	:	125-130 days
Yield	:	14.45 q/ha
Special features	:	Attractive seed size (15.9 gm/ 100 seeds), tolerance against Fusarium wilt and Root rot, good level of protein 20.5 %

4. Awadh (GNG 2207)

Release & notification	:	2021
Agronomic features	:	Timely Sown Irrigated conditions
Area of recommendation	:	NEPZ (Uttar Pradesh, West Bengal, Bihar, Assam, and Jharkhand)
Planting duration	:	130-135 days
Yield	:	16-17 q/ha
Special features	:	Attractive seed size (17.4 gm/ 100 seeds), tolerance against Fusarium wilt and Root rot, good level of protein 23.11 %

5. Meera (GNG 2171)

Release & notification	:	2017
Agronomic features	:	Timely Sown Irrigated conditions
Area of recommendation	:	NWPZ
Planting duration	:	133-137 days
Yield	:	20-22 q/ha
Special features	:	Attractive brownish yellow seed colour, Attractive seed size (16.5 gm/ 100 seeds), tolerance against Fusarium wilt, Ascochyta Blight and Root rot, good level of protein 22.5 percent

6. Teej (GNG-2144)

Release & notification	:	2016
Agronomic features	:	Late Sown Irrigated conditions
Area of recommendation	:	NWPZ
Planting duration	:	130-135 days
Yield	:	18-20 q/ha
Special features	:	Twin flowered, Attractive seed size (15.9 gm/ 100 seeds), tolerance against wilt, Ascochyta Blight and Root rot, good level of protein 21.09 percent

7. GNG 1958 (Marudhar)

Release & notification	:	2013
Agronomic features	:	Normal Sown, Irrigated conditions
Area of recommendation	:	NWPZ
Planting duration	:	145-150 days
Yield	:	25.2 q/ha
Special features	:	Bold seeded (25.4 g/100 seeds), Resistant toWilt, Profuse branching, Semi erect

8. GNG 1969 (Triveni-Kabuli)

Release & notification	:	2013
Agronomic features	:	Normal Sown, Irrigated conditions
Area of recommendation	:	NWPZ
Planting duration	:	146-150 Days
Yield	:	22-23 q/ha
Special features	:	It possesses creamy beige seed colour with large seeds size (26.2g/100), resistant to wilt

9. Ganguar (GNG1581)

Release & notification	:	2008
Agronomic features	:	Normal sown, Irrigated conditions
Area of recommendation	:	NWPZ
Planting duration	:	151-155 days
Yield	:	24-25 q/ha
Special features	:	Profuse branching and podding, a greater number of seeds per pod. Attractive seed size (16 gm/ 100 seeds), tolerance against wilt and root rot, good level of protein 21.88 percent.

10 Gauri (GNGK 1499)

Release & notification	:	2007
Agronomic features	:	Irrigated conditions
Area of recommendation	:	Rajasthan
Planting duration	:	143 days
Yield	:	18-20 q/ha
Special features	:	Tolerant to Dry Root Rot, Stunt and Wilt.

11. Sangam (GNG 1488)

Release & notification	:	2007
Agronomic features	:	Late sown conditions
Area of recommendation	:	Rajasthan
Planting duration	:	134 Days
Yield	:	18-20 q/ha
Special features	:	Tolerant to Root Rot, Stunt. Resistant to *Heliothis* (Pod Borer).

2.2.3 Varieties developed by ARS, Kota

2.2.3.1 Chickpea (*Cicer arietinum* L.)

1. Kota Desi Chana 2 (RKGM 20-1)

Release & notification	:	2024
Agronomic features	:	Timely sown , irrigated conditions
Area of recommendation	:	South Zone comprising of Andhra Pradesh, Karnataka
Planting duration	:	94-96 days
Yield	:	20 q/ha
Special features	:	Seed index: 24.73 g, medium tall plants and erect, suitable for mechanical harvesting, resistant to wilt, dry root rot, collar rot and stunt

2. Kota Desi Chana 3 (RKGM 20-2)

Release & notification	:	2024
Agronomic features	:	Timely Sown, irrigated conditions
Area of recommendation	:	North East Plain Zone comprising of Assam, Bihar, Jharkhand, West Bengal
Planting duration	:	126-132 Days
Yield	:	15.57 q/ha
Special features	:	Seed index: 26.43 g, medium tall plants, suitable for mechanical harvesting, resistant wilt, dry root rot, collar rot and stunt

3. Kota Desi Chana 4 (RKG 13-380)

Release & notification	:	2024
Agronomic features	:	Timely sown Irrigated conditions
Area of recommendation	:	Rajasthan
Planting duration	:	118 days
Yield	:	30.79 q/ha
Special features	:	100-Seed wt. (g): 22.16, Moderately resistant to wilt and dry root rot disease

4. Kota Desi Chana 6 (RKG 19-1)

Release & notification	:	2024
Agronomic features	:	Timely sown irrigated conditions
Area of recommendation	:	Rajasthan
Planting duration	:	109-114 days
Yield	:	22.16 q/ha
Special features	:	100-Seed wt. : 25.53 g resistant to wilt, dry root rot, collar rot

5. Kota Desi Chana 5 (RKG 13-515-1)

Release & notification	:	2024
Agronomic features	:	Timely sown irrigated conditions
Area of recommendation	:	Rajasthan
Planting duration	:	122 days
Yield	:	29.17 q/ha
Special features	:	100-Seed wt. 23.06g Moderately resistant to wilt and dry root rot disease

6. Kota Kabuli Chana 4 (RKGK 13-416)

Release & notification	:	2023
Agronomic features	:	Timely sown irrigated conditions
Area of recommendation	:	SZ comprising of Andhra Pradesh, Karnataka.
Planting duration	:	98 days
Yield	:	16-17 q/ha
Special features	:	Seed index: 26.83g, maturity: 98 days, resistant to wilt, dr y root rot, collar rot and stunt

7. Kota Kabuli Chana 2 (RKGK 13-499)

Release & notification	:	2021
Agronomic features	:	Timely Sown, irrigated conditions
Area of recommendation	:	NWPZ comprising of Punjab, Haryana, Western UP, Delhi, North Rajasthan , Jammu & Kashmir.
Planting duration	:	128 days
Yield	:	20.9 q/ha
Special features	:	Extra-large seeded kabulivariety seed index: >40g, resistant to wilt, dry root rot and collar rot

8. Kota Kabuli Chana 3 (RKGK 13-414)

Release & notification	:	2021
Agronomic features	:	Timely Sown, irrigated conditions
Area of recommendation	:	WCZ comprising of Madhya Pradesh, Maharashtra, Gujarat, Southern Rajasthan and Bundelkhand region of Uttar Pradesh
Planting duration	:	128 days
Yield	:	21-22 q/ha
Special features	:	Seed index: 26g, resistant to wilt, dry root rot and collar rot

9. Kota Desi Chana 1 (RKG 13-515)

Release & notification	:	2020
Agronomic features	:	Normaland late sown conditions
Area of recommendation	:	Rajasthan
Planting duration	:	104-115 Days
Yield	:	16-18 q/ha
Special features	:	Tolerant to major diseases (wilt & root rot) and pod borer

10. Kota Kabuli Chana 1 (RKGK 13-271)

Release & notification	:	2020
Agronomic features	:	Normal and late sown, lodging resistant
Area of recommendation	:	Rajasthan
Planting duration	:	114 days
Yield	:	19.86 q/ha
Special features	:	Medium bold (34g/100 seed), Resistant to wilt

2.2.3.2 Fieldpea (*Pisum sativum* L.)

1. Kota Matar 1 (KPF 101)

Release & notification	:	2020
Agronomic features	:	Irrigated conditions
Area of recommendation	:	Fieldpea growing areas of Rajasthan
Planting duration	:	109-113 days
Yield	:	18-22q/ha
Special features	:	Early in maturing, semi-spreading tendrilled plant type, bold seed, moderate resistant to wilt.

2.2.3.3 Rajmash (*Phaseolus Vulgaris* L.)

1. Kota Rajmash 1 (RKR 1033)

Release & notification	:	2018
Agronomic features	:	Irrigated conditions
Area of recommendation	:	Central Zone of India
Planting duration	:	101 days
Yield	:	16-18 q/ha
Special features	:	Medium seed size (30.7 g/100 seed-weight), brown attractive seeds with variegated seed coat, semi -erect and determinate dwarf plant type with ovate leaves, pods are pale green at maturity, lodging resistance

2.2.3.4 Lentil (*Lens culineris* L.)

1. Kota Masoor 1 (RKL 607-1)

Release & notification	:	2018
Agronomic features	:	Rainfed conditions
Area of recommendation	:	Central Zone of India
Planting duration	:	100-106 days
Yield	:	14-16 q/ha
Special features	:	Early maturing, bold seed, Moderate resistant to wilt and aphids

2. Kota Masoor 2 (RKL 14-20)

Release & notification	:	2018
Agronomic features	:	Rainfed conditions
Area of recommendation	:	Central Zone of India
Planting Duration	:	100-104 days
Yield	:	12-164 q/ha
Special features	:	Early maturing, tendrils are absent of leaflets, bold seed, moderate resistant to wilt.

3. Kota Masoor 3 (RKL 605-03)

Release & notification	:	2020
Agronomic features	:	Rainfed conditions
Area of recommendation	:	Central Zone of India
Planting duration	:	100-105 days
Yield	:	18-20 q/ha
Special features	:	Early maturing, erect plant type, bold seed, moderate resistant to wilt.

4. Kota Masoor 4 (RKL 58F-3715)

Release & notification	:	2020
Agronomic features	:	Rainfed conditions
Area of recommendation	:	Central Zone of India
Planting duration	:	104-108 days
Yield	:	18-20 q/ha
Special features	:	Medium in maturing, semi - spreading plant type, bold seed, moderate resistant to wilt.

5. Kota Masoor 5 (RKL)

Release & notification	:	2025
Agronomic features	:	Rainfed conditions
Area ofrecommendation	:	Lentil growing area of Rajasthan
Planting duration	:	102-106 days
Yield	:	15-17 q/ha
Special features	:	Semi-erect and determinate plant type with ovatenon-tendrilled leaves, brown, attractive seeds with dotted seed coat pattern and orange cotyledons

6. Kota Masoor 6 (RKL 20-26)

Release&notification	:	2024
Agronomic features	:	Rainfed conditions
Area of recommendation	:	NWPZ & CZ of India
Planting duration	:	102-106 days
Yield	:	18-20 q/ha
Specialfeatures	:	Early in maturing, semi - spreading plant type, bold seed, moderate resistant to wilt.

Unit 3

BREEDER SEED PRODUCTION OF MAJOR PULSES IN RAJASTHAN

S. K. Jain, S. S. Rajput, Preeti Verma, Khajan Singh, R. R. Choudhary, Manish Kumar & S. S. Punia

Breeder seed production forms the foundational tier in the seed multiplication chain,ensuring the genetic purity and quality of subsequent seed classes. Rajasthan, with its diverse agro-climatic zones and robust agricultural research infrastructure, plays a pivotal role in the breeder seed production of major pulse crops in India. Over the decade from 2015–16 to 2024–25, the state has not only met but often surpassed its breeder seed indent targets, reflecting effective planning and execution of breeding programs. Chickpea and clusterbean are dominant pulse crop in the region, accounts for over 30% of the national indent and shows consistent alignment between seed demand and production, underscoring its strategic importance. Other key pulses like mungbean, urdbean, lentil, and cowpea also demonstrate varying degrees of breeder seed production with Rajasthan uniquely contributing 100% of the national mothbean indent. The performance of these crops' highlights both the strengths and challenges of pulse seed production in the state, ranging from overachievement in production to shortfalls due to agronomic or infrastructural constraints. This unit explores the crop- and variety-wise breeder seed production trends for kharif and rabi pulses in Rajasthan, offering insights into seed planning efficiency, production dynamics, and the state's critical role in national pulse seed security.

3.1 Indent and Production of Breeder Seed for Major Pulse Crops

Table 3.1: Breeder seed indent for *kharif* pulses for Rajasthan during 2015-16 to 2024-25

S. No	Crop	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25	Total
1	Clusterbean	129.5	123.15	104.9	64.7	63.2	82.1	61.1	57.5	98.0	73.5	857.8
2	Mungbean	41.0	130.0	70.0	119.0	69.0	159.0	25.0	63.5	48.6	39.0	764.1
3	Urdbean	10.0	25.0	32.0	36.0	38.0	109.0	94.0	67.0	163.0	177.0	751.0
4	Cowpea	9.0	19.0	5.0	7.7	8.0	7.7	10.0	8.5	6.5	4.8	86.2
	Total	**189.5**	**297.1**	**211.9**	**227.4**	**178.2**	**357.8**	**190.1**	**196.5**	**316.1**	**294.3**	**2459.1**

Table 3.2: Breeder seed production of *kharif* pulses in Rajasthan during 2015-16 to 2024-25

S. No	Crop	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25	Total
1	Clusterbean	125.4	158.6	145.9	110.2	97.1	131.2	134.0	66.7	162.1	150.8	1282.2
2	Mungbean	18.5	108.8	71.0	95.1	107.1	182.2	43.5	69.7	45.2	63.5	804.9
3	Urdbean	10.0	59.0	61.0	90.0	8.5	24.0	14.0	82.5	86.2	144.0	579.2
4	Cowpea	3.8	23.4	8.1	6.5	6.7	7.8	8	11.	1.3	9.3	86.4
	Total	**157.7**	**349.8**	**286.0**	**301.8**	**219.5**	**345.2**	**199.5**	**230.3**	**295.0**	**367.7**	**2752.8**

Table 3.3: Breeder seed indent for *rabi* pulses for Rajasthan during 2015-16 to 2024-25

S. No	Crop	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25	Total
1	Chickpea	2380	1986	2727.8	2851.0	3194.5	2310	1845.3	1886.3	1617.0	1842.0	22639.9
2	Lentil	-	-	40.0	56.0	126.0	97.0	70.5	160.5	219.5	263.9	1033.4
3	Fieldpea	-	-	50.0	35.0	80.0	50.0	65.0	60.0	30.0	0.30	370.3
	Total	**2380**	**1986**	**2817.8**	**2942**	**3400.5**	**2457**	**1980.8**	**2106.8**	**1866.5**	**2106.2**	**24043.6**

Table 3.4: Breeder seed production of *rabi* pulses in Rajasthan during 2015-16 to 2024-25

S. No	Crop	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25	Total
1	Chickpea	2765.6	2051.2	2245.1	3872.2	3374.2	2636.8	1893.3	2615.5	1621.9	2265.0	25340.8
2	Lentil	0	0	40.0	92.8	147.3	36.3	134.5	114.8	328.3	436.9	1330.9
3	Fieldpea	0	0	45.17	57.4	79.5	68.0	86.9	9.6	23.6	3.5	373.7
	Total	**2765.6**	**2051.2**	**2330.27**	**4022.4**	**3601.0**	**2741.1**	**2114.7**	**2739.9**	**1973.8**	**2705.4**	**27045.4**

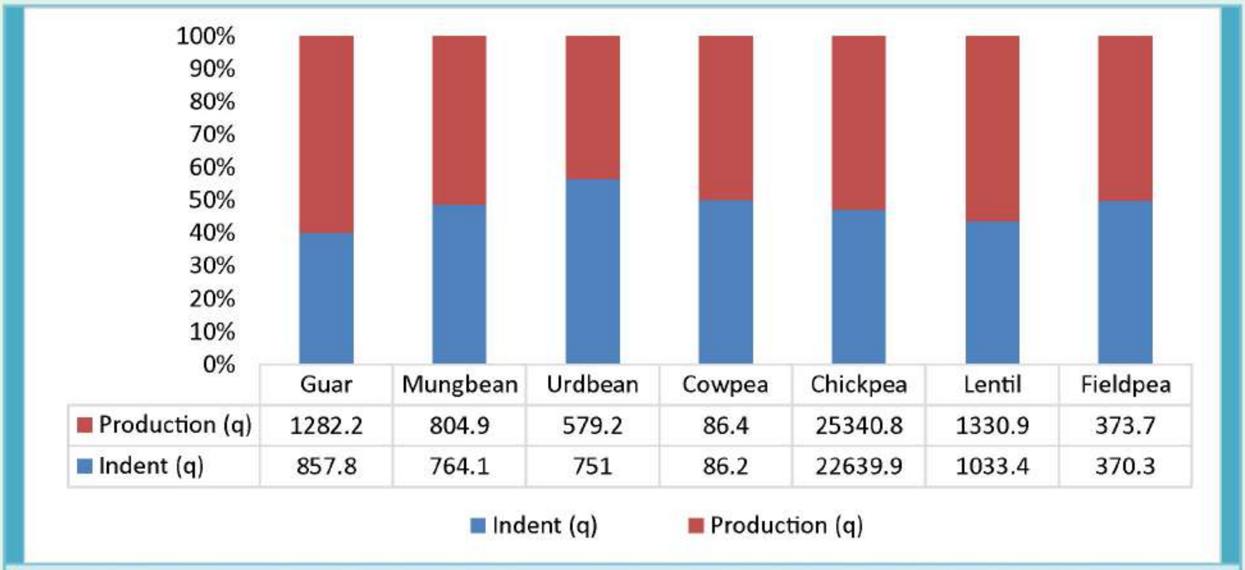


Fig. 3.1: Breeder seed production of pulses against indent for Rajasthan during 2015-16 to 2024-25

The stacked bar chart presents a comparative analysis of indent versus production of pulses breeder seed in Rajasthan from 2015-16 to 2024-25 across seven pulse crops. Chickpea demonstrates overwhelming dominance in indent (22,639.9 q) and production (25340.8 q), far surpassing all other pulses combined and indicating its critical importance in the region's pulse cultivation landscape. Lentil ranks second in production (1,330.9 q) despite a comparatively lower indent (1033.4 q), suggesting exceptional efficiency in breeding programs or higher-than-anticipated seed multiplication rates. Guar and mungbean also show substantial production values (1282.2 and 804.9 q, respectively) against their corresponding indents (857.8 and 764.1 q). Interestingly, urdbean presents a unique case where production (579.2 q) falls below indent (751 q), indicating potential challenges in meeting seed production targets. Fieldpea and cowpea demonstrates the most balanced relationship with production nearly matching indent, suggesting precise planning and execution in its seed production program. Overall, the data reveals varying levels of breeding efficiency across pulse crops in Rajasthan, with most crops exceeding indent requirements, which reflects the state's robust pulse breeding infrastructure capable of meeting and often surpassing the planned targets for breeder seed production.

Table 3.5: Rajasthan share in breeder seed indent of pulses (2015-16 to 2024-25)

S. No.	Crop	India	Rajasthan	Rajasthan's Contribution (%)
1.	Chickpea	74448.7	22639.9	30.41
2.	Mungbean	6844.9	764.1	11.16
3.	Mothbean	348.7	348.7	100.00
4.	Clusterbean	1832.1	857.8	46.82
5.	Urdbean	4767.8	751.0	15.75
6.	Lentil	4814.1	1033.4	21.47
7.	Cowpea	766.1	86.3	11.26

The data on breeder seed indent of kharif pulses from 2015–16 to 2024–25 highlights Rajasthan's significant role in national seed production. Among the crops, mothbean stands out with Rajasthan contributing 100% of the total national indent, reflecting the state's exclusive dominance in its breeder seed production. Clusterbean also shows a strong contribution, with Rajasthan supplying 46.82% of the national requirement, followed by chickpea at 30.41%, indicating the state's robust seed production infrastructure and agro-climatic suitability for these crops. Although the contributions for urdbean (15.75%), lentil (21.47%), mungbean (11.16%), and cowpea (11.26%) are comparatively lower, they still signify Rajasthan's diverse engagement in pulse seed production. These figures collectively underscore the state's pivotal role in strengthening pulse production and ensuring seed security in India, especially for arid and semi-arid region-adapted crops.

3.2 Variety-Wise Breeder Seed Production of Major Pulse Crops

3.2.1 Clusterbean

Table 3.6: Variety-wise breeder seed production of clusterbean during 2015-16 to 2024-25

S. No	Varieties	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25	Total
1	RGC 936	9.0	8.6	16.0	2.1	-	-	-	-	3.7	32.2	71.6
2	RGC 1066	10.0	38.2	6.0	2.5	1.6	2.0	3.6	7.5	14.3	13.9	99.6
3	RGC 1055	22.0	30.0	18.5	5.0	1.0	-	4.8	1.2	-	-	82.5
4	RGC 1033	50.0	38.0	45.0	80.0	51.5	66.2	27.0	-	-	16.7	374.4
5	RGC 1002	2.5	-	-	1.25	-	-	-	-	-	-	3.75
6	RGC 1038	26.9	38.1	60.0	12.0	38.0	50.0	29.6	-	23.0	12.1	289.7
7	RGC 1003	5.0	5.7	-	-	1.0	-	-	-	10.0	-	21.7
8	RGC 197	-	-	0.2	0.1	-	-	-	-	-	-	0.3
9	RGC 1017	-	-	0.2	3.3	3.0	-	-	-	-	-	6.5
10	RGC 986	-	-	-	4.0	1.0	-	-	-	-	-	5.0
11	RGC 1031	-	-	-	-	-	-	-	-	8.5	8.0	16.5
12	RGr 12-1	-	-	-	-	-	13.0	69.0	58.0	82.6	9.85	232.45
13	RGr 18-1	-	-	-	-	-	-	-	-	20.0	28.9	48.9
14	RGr 20-15	-	-	-	-	-	-	-	-	-	28.9	28.9
	Total	**125.4**	**158.6**	**145.9**	**110.2**	**97.1**	**131.2**	**134.0**	**66.7**	**162.1**	**150.5**	**1281.8**

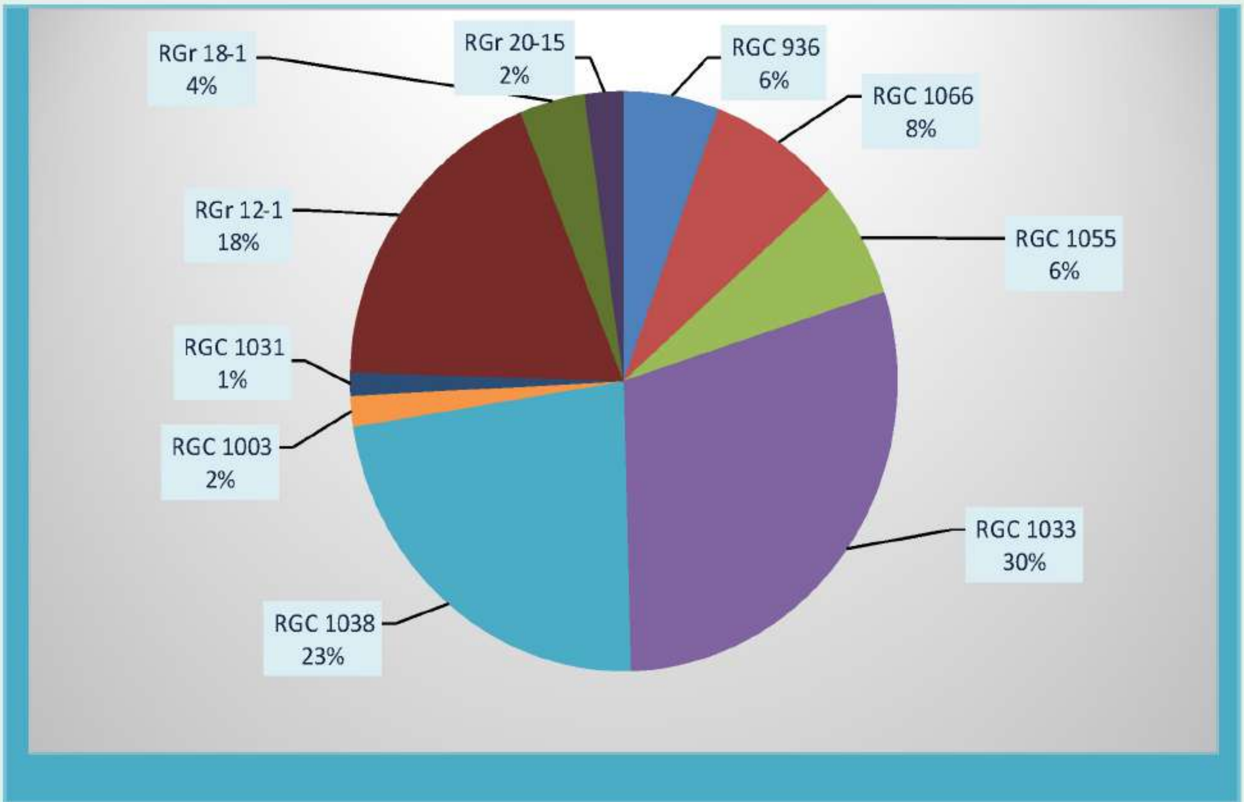


Figure 3.2: Variety-wise breeder seed production in clusterbean during 2015-16 to 2024-25

The Figure 3.2 data demonstrate the diverse distribution of clusterbean (guar) varieties in breeder seed production. RGC 1033 emerged as the dominant variety with the highest breeder seed production (30%), followed closely by RGC 1038 (23%), suggesting these two varieties account for over half of the total clusterbean cultivation. RGr 12-1 represented a significant portion at 18%, establishing itself as the third most preferred variety. The remaining breeder seed production of several varieties with notably lower adoption rates: RGC 1066 (8%), RGC 936 (6%), RGC 1055 (6%), RGr 18-1 (4%), RGr 20-15 (2%), RGC 1003 (2%), and RGC 1031 (1%). This varietal distribution pattern reflects farmers' preferences based on adaptability to local agro-climatic conditions, yield potential, disease resistance, and market demand. The predominance of RGC 1033 and RGC 1038 likely indicates their superior performance in terms of productivity, drought tolerance, or quality attributes valued by farmers and the guar gum industry. RGr 18-1 and RGr 20-15 are newly released varieties, and breeder seed production of these varieties is projected to increase substantially in the coming years, enhancing their availability to seed producers and farmers.

3.2.2 Chickpea

Table 3.7: Variety-wise breeder seed production of chickpea in Rajasthan during 2015-16 to 2023-24

S. No	Varieties	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	Total
1	CSJ 515	151.0	216.0	233.0	1393.9	230.0	183.0	-	17.5	58	2482.4
2	RSG 963	63.0	3.0	10.5	19.0	-	-	-	-	-	95.5
3	RSG 991	-	-	-	-	-	-	-	-	-	0
4	RSG 896	-	-	-	-	-	-	-	-	-	0
5	RSG 902	41.0	20.0	39.0	-	-	-	-	-	-	100
6	RSG 888	36.0	2.3	2.1	-	-	-	-	-	-	40.4
7	RSG 973	41.0	6	-	-	-	-	-	-	5.0	52
8	RSG 974	570.0	396.3	327.9	161.0	117.0	-	-	-	-	1572.2
9	RSG 945	24.0	22	-	-	-	-	-	-	-	46
10	RSG 931	7.0	-	-	-	-	-	-	-	-	7
11	RSG 895	54.0	39	-	-	-	-	-	-	-	93
12	RSG 807	-	-	-	-	-	2.0	-	-	15.0	17
13	GNG 663	9.0	10.2	12.9	-	-	-	-	-		32.1
14	GNG 469	30.0	-	-	-	-	-	-	-		30.0
15	GNG 1958	330.8	461.6	573.7	647.6	797.2	470.8	94.4	65.8	22.0	3463.9
16	GNG 1581	1398.3	814.6	505.9	180.0	103.0	173.8	88.3	79.2	180.0	3523.1
17	PGC 1	10.5	26.2	33.0	40.2	-	-	-	-	-	109.9
18	GNG 1499	-	5.2	-	-	-	-	-	-	-	5.2
19	GNG 2144	-	65.0	253.0	738.0	1257.8	984.1	640.3	750.4	431.6	5120.2
20	GNG 2171	-	23.6	247.2	684.5	578.8	700.0	865.7	1459.6	568.0	5127.4
21	GNG 1969	-	7.2	-	8.0	39.9	-	-	-	-	55.1
22	GNG 1488	-	-	7.0	-	-	-	-	-	-	7
23	GNG 2207	-	-	-	-	138.5	99.4	132.4	43.7	62.8	476.8
24	GNG 2299					82.0	23.8	72.2	45.7	68.0	291.7
25	GNG 2261	-	-	-	-	-	-	-	141.7	258.0	399.7
26	KDC 1	-	-	-	-	-	-	-	12.0		12
27	CSJK 174	-	-	-	-	-	-	-	-	4.0	4
28	KKC 3	-	-	-	-	-	-	-	-	7.5	7.5
	Total	**2765.6**	**2051.2**	**2245.1**	**3872.2**	**3374.2**	**2636.8**	**1893.3**	**2615.5**	**1621.9**	**23075.8**

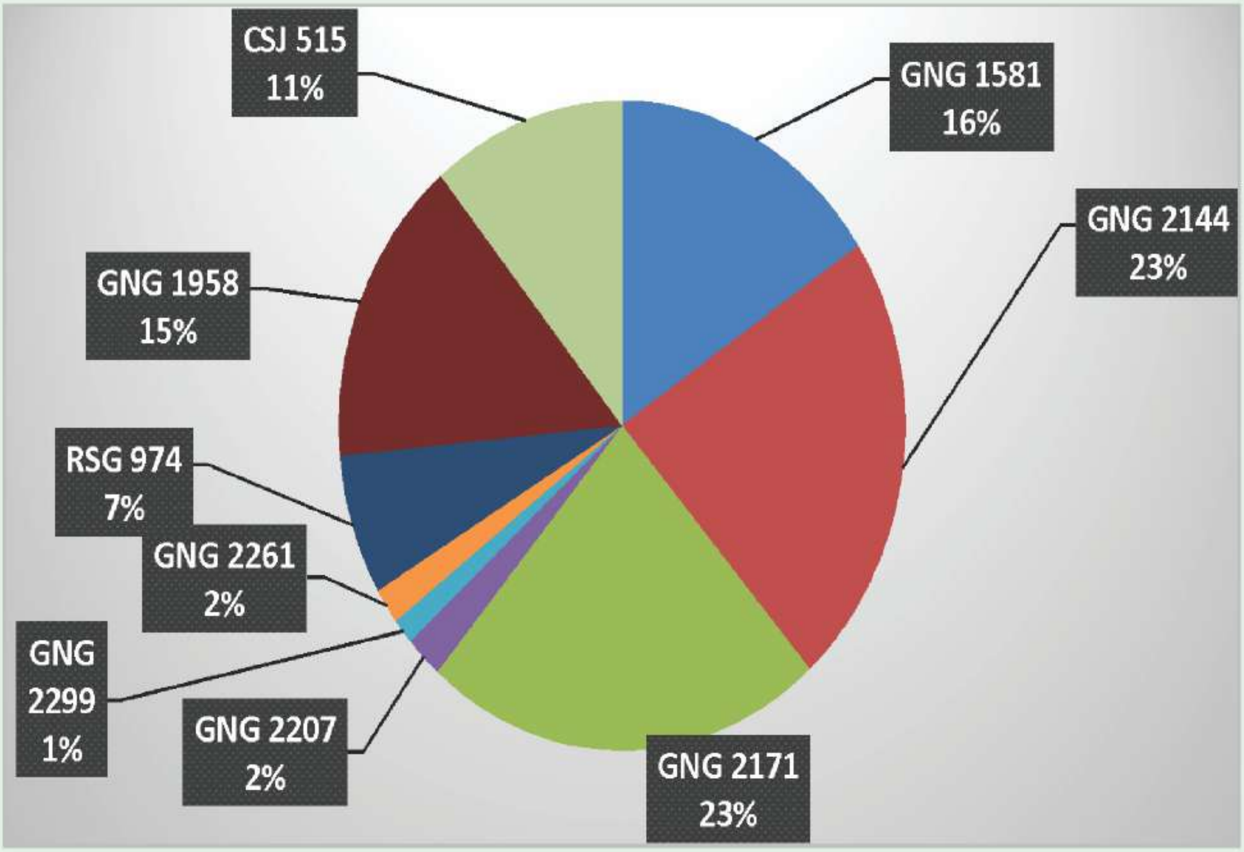


Figure 3.3: Variety-wise breeder seed production in chickpea during 2015-16 to 2024-25

The Figure 3.3 illustrates the contribution of chickpea varieties in Rajasthan's breeder seed indent. The graph reveals that GNG 2144 and GNG 2171 are equally predominant, each accounting for 23% of the breeder seed indent. These two varieties together constitute nearly half (46%) of all chickpea production, indicating strong farmer preference for their characteristics. GNG 1581 and GNG 1958 follow as the next most widely adopted varieties at 16% and 15% respectively, demonstrating significant farmer acceptance. RSG 974 & CSJ 515 accounts for a moderate 7% & 11% of the cultivated area, while the remaining varieties show considerably lower adoption rates: GNG 2261 (2%), GNG 2207 (2%) and GNG 2299 (1%). This varietal distribution pattern likely reflects farmer's choices based on several factors including yield potential, disease and pest resistance, drought tolerance, market demand, and adaptability to local agro-climatic conditions. The clear dominance of GNG 2144 and GNG 2171 suggests these varieties offer superior performance attributes valued by farmers in the region, such as higher productivity, better grain quality, or greater resilience to environmental stresses. The limited adoption of newer varieties like GNG 2299 indicates potential opportunities for targeted extension activities to demonstrate their benefits and increase their cultivation footprint in future growing seasons.

3.2.3 Mungbean

Table 3.8: Variety-wise breeder seed production of mungbean in Rajasthan during 2015-16 to 2024-25

S. No	Varieties	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25	Total
1	SML 668	3.68	12.50	9.20	-	-	-	-	-	-	-	25.38
2	RMG 492	3.90	28.00	-	-	-	-	-	-	-	-	31.90
3	IPM 2-03	11.00	43.00	27.00	20.10	-	4.20	-	-	-	-	105.30
4	MH 421	-	18.20	8.80	20.00	61.00	35.00	5.00	11.00	7.78	5	171.78
5	IPM 2-14	-	2.10	-	-	34.00	-	-	-	-	-	36.10
6	SMARAT	-	5.00	-	-	-	-	-	-	-	-	5.00
7	RMG 975	-	-	16.00	28.00	2.19	60.00	13.00	11.80	-	-	130.99
8	MSJ 118	-	-	10.00	27.00	-	20.00	5.70	2.00	-	-	64.70
9	SIKHA	-	-	-	-	6.00	43.00	15.00	3.25	9.17	16	92.42
10	IPM 205-7	-	-	-	-	4.00	20.00	4.80	1.50	4.40	-	34.70
11	IPM 512-1	-	-	-	-	-	-	-	-	23.90	12.73	36.63
12	MH 1142	-	-	-	-	-	-	-	40.20	-	20	60.20
13	MH 1762	-	-	-	-	-	-	-	40.20	-	3.6	43.80
	Total	**18.58**	**108.80**	**71.00**	**95.10**	**107.19**	**182.20**	**43.50**	**69.75**	**45.25**	**53.73**	**795.10**

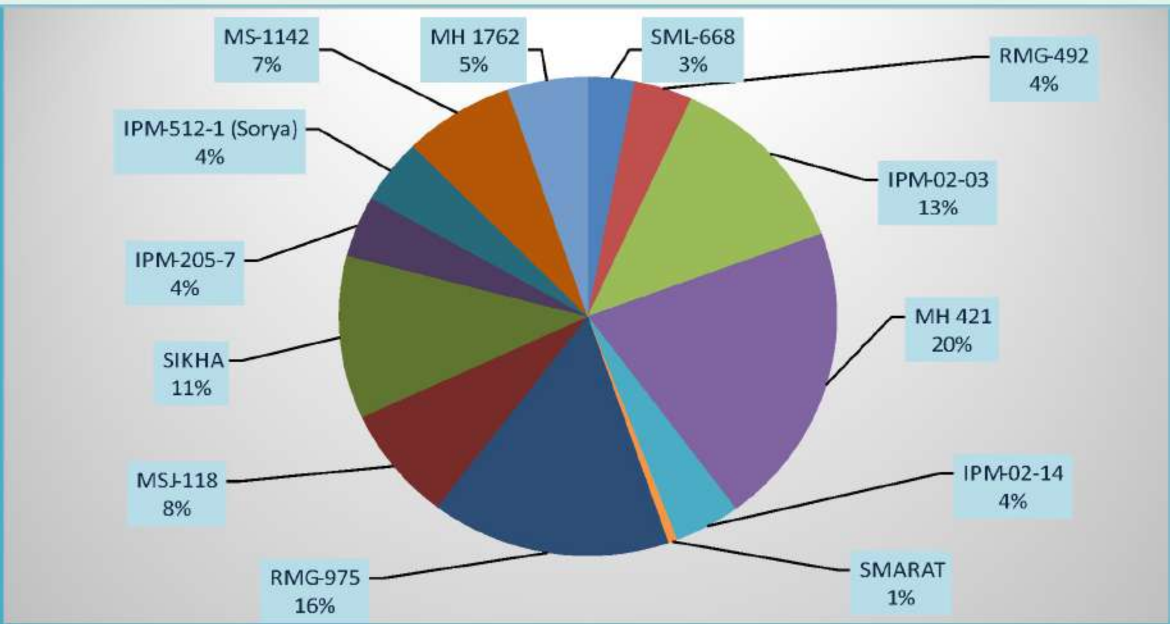


Figure 3.4: Variety-wise breeder seed production in mungbean during 2015-16 to 2024-25

The Figure 3.4 & Table 3.7 of mungbean varieties breeder seed production revealed that 'MH 421' dominated with the highest share at 20%, indicating its strong adaptability and farmer preference due to its superior yield and disease resistance traits, particularly YVMV. 'RMG-975' followed closely, accounting for 16% of the total, suggesting its widespread acceptance in moongbean cultivation. 'IPM-02-03' (13%) and 'SIKHA' (11%) also showed significant contributions, reflecting their promising agronomic performances under diverse conditions. 'MSJ-118' held an 8% share, while 'MH 1142' and 'MH 1762' contributed 7% and 5%, respectively, highlighting their moderate adoption. Lesser percentages were observed for varieties like 'IPM-205-7', 'IPM-512-1', 'RMG-492', and 'IPM 02-14', each at 4%, and 'SML-668' at 3%, which might be due to their niche adaptability or specific regional preference. 'SMARAT' showed the least share at 1%, indicating limited adoption, perhaps due to lower yield potential or less farmer familiarity. Overall, the dominance of a few varieties reflects focused breeding efforts and varietal dissemination, while the lower shares underline the need for targeted extension activities to promote varietal diversity in mungbean cultivation.

3.2.4 Cowpea

The analysis of cowpea varieties breeder seed production data (Figure 3.5 & Table 3.9) indicated that 'RC-101' was the most dominant, covering 49% of the total share, highlighting its superior performance in terms of yield, adaptability, and farmer preference. 'RC-19' followed with a 21% share, suggesting it also holds significant promise under prevailing cultivation conditions. 'CPD-119' accounted for 20%, showing its competitiveness and potential as an alternative choice for growers. Meanwhile, 'TC-901' contributed 10%, representing a smaller but notable proportion, which could be attributed to its suitability in specific niches or farmer familiarity in limited regions. Overall, the results reflect that while 'RC-101' overwhelmingly leads cowpea cultivation, other varieties like 'RC-19' and 'CPD-119' are also important players, and there is scope to enhance the adoption of promising lines like 'TC-901' through targeted extension and promotional efforts.

Table 3.9: Variety-wise breeder seed production of cowpea in Rajasthan during 2015-16 to 2024-25

S. No	Varieties	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25	Total
1	RC-101	3.00	23.00	4.60	3.50	4.88	3.30	-	-	-	-	42.28
2	RC-19	0.80	0.45	3.50	3.00	1.85	4.50	-	1.85	-	2.3	18.25
3	CPD 119	-	-	-	-	-	-	8.00	1.00	1.38	7	17.38
4	TC 901	-	-	-	-	-	-	-	8.50		-	8.50
	Total	**3.80**	**23.45**	**8.10**	**6.50**	**6.73**	**7.80**	**8.00**	**11.35**	**1.38**	**9.30**	86.41

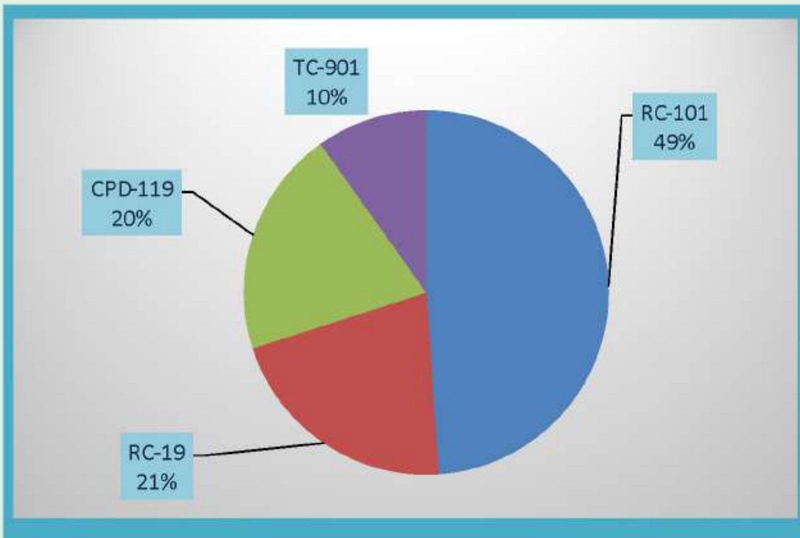


Figure 3.5: Variety-wise breeder seed production in cowpea during 2015-16 to 2024-25

3.2.5 Urdbean

The evaluation of urdbean varieties breeder seed production in Rajasthan (Figure 3.6 & Table 3.10) showed that 'Pratap Urd 1' was the most predominant, covering 42% of the total, reflecting its high yield potential and adaptability. 'KU 3' (21%) and 'KU-4' (20%) also made significant contributions, suggesting strong performance and farmer acceptance. 'MU 2' accounted for 13%, while minor shares were observed for 'IPU 13-01' (2%), 'IPU 11-02' (1%), and 'IPU 10-26' (1%), indicating limited adoption in the state. KU 5' showed negligible representation as it is a newly released improved variety, which is yet to gain wider adoption. Overall, a few varieties dominated urd cultivation, highlighting successful breeding efforts but also suggesting a need to diversify variety use for greater resilience.

Table 3.10: Variety-wise breeder seed production of urdbean in Rajasthan during 2015-16 to 2024-25

S.No.	Variety	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25	Total
1	PU 1	10.00	55.00	50.00	60.00	14.5	11.00	6.00	22.00	7.68	30	**266.18**
2	MU 2	-	4.00	11.00	30.00	8.50	9.50	2.00	4.50	1.31	9.9	**80.71**
3	KU 3	-	-	-	-	-	-	2.00	16.00	44.70	67.4	**130.10**
4	KU 4	-	-	-	-	-	-	4.00	40.00	29.82	54.7	**128.52**
5	KU 5	-	-	-	-	-	-	-	-	1.20		**1.20**
6	IPU 13-01									1.06	12.15	**13.21**
7	IPU 10-26									0.51	3.48	**3.99**
8	IPU 11-02										5.79	**5.79**
	Total	**10.00**	**59.00**	**61.00**	**90.00**	**23.00**	**20.50**	**14.00**	**82.50**	**86.28**	**177.63**	**623.91**

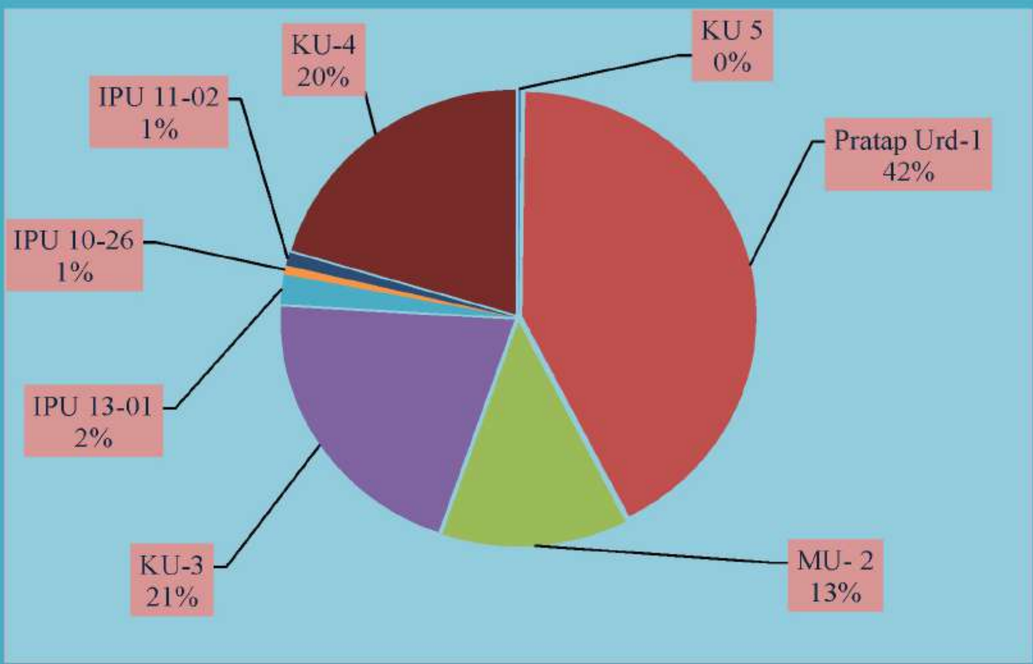


Figure 3.6: Variety-wise breeder seed production in urdbean during 2015-16 to 2024-25

3.2.6 Lentil

The breeder seed production data of lentil varieties (Figure 3.7) showed that 'Kota Masoor 3' led with 28% share, indicating its strong performance and wide acceptance among farmers. 'Kota Masoor 1' (25%) and 'Kota Masoor 2' (20%) also demonstrated significant adoption, suggesting good adaptability and yield potential. The new variety 'Kota Masoor 4' accounted for 19%, reflecting its popularity among lentil growers in initial phase. 'RLG 5' contributed only 8%, possibly due to its limited promotion or specific adaptability. Overall, Kota Masoor series varieties dominate lentil cultivation, highlighting the success of regional breeding programs in addressing farmer's needs.

Table 3.11: Variety-wise breeder seed production of lentil in Rajasthan during 2017-18 to 2024-25

S. No	Varieties	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25	Total
1	RLG 5	-	23.0	46.0	7.0	-	26.2	-	-	**102.2**
2	Kota Masoor 1	25.0	40.3	66.5	12.8	52.5	31.0	32.7	58.7	**319.6**
3	Kota Masoor 2	-	29.5	30.0	13.7	13.4	22.0	53.7	102.7	**265.1**
4	Kota Masoor 3	-	-	4.8	2.8	35.3	18.5	78.2	230.0	**369.6**
5	Kota Masoor 4	-	-	-	-	33.2	17.0	40.0	151.1	**241.3**
6	**Total**	**25.0**	**92.8**	**147.3**	**36.4**	**134.4**	**114.7**	**204.6**	**542.6**	**1298.0**

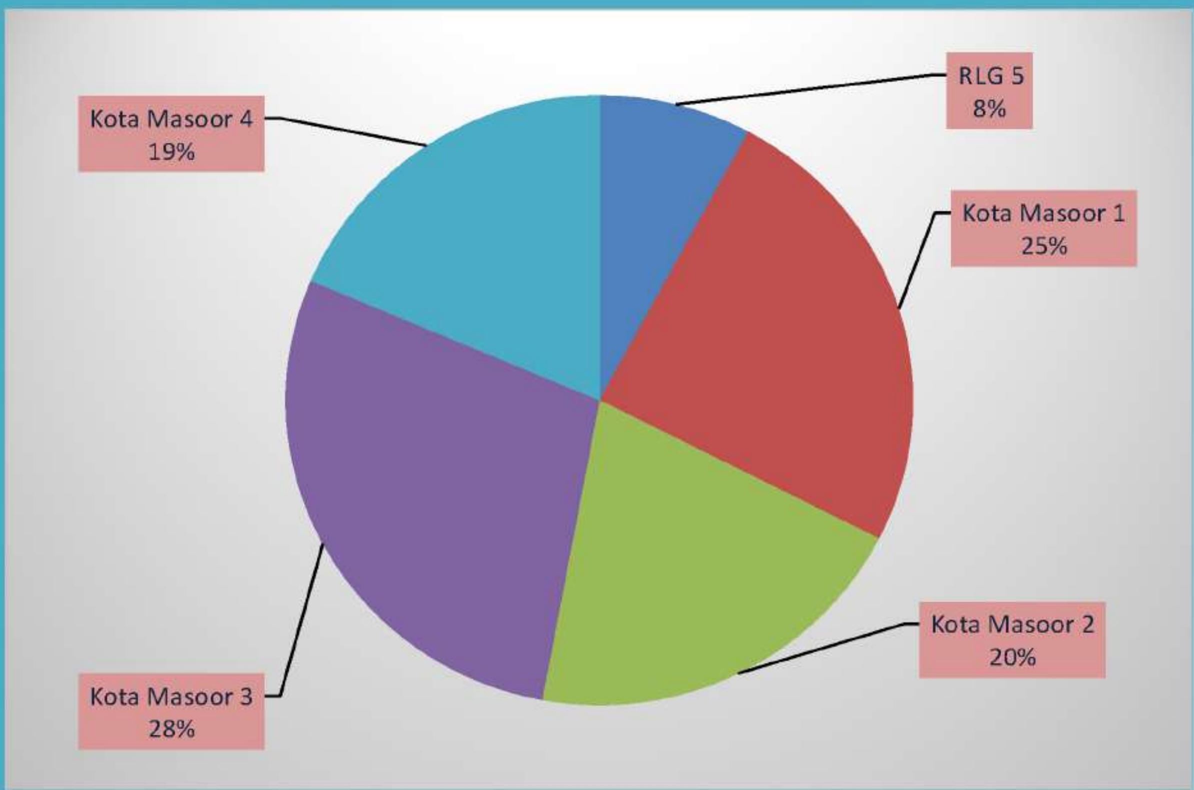


Figure 3.7: Variety-wise breeder seed production in lentil during 2017-18 to 2024-25

Unit 4

MAJOR DISEASES OF PULSE CROPS

Arvind M. & M. A. Khan

Pulses, an essential component of diets and agriculture, are vulnerable to a variety of diseases that can severely impact yield and quality. These diseases, caused by fungi, bacteria and viruses, affect important crops like mungbean, urdbean, cowpea, chickpea, clusterbean, lentil and others. Factors such as weather conditions, seed quality and crop management practices influence the occurrence and severity of infections. Early identification and proper management are crucial to prevent widespread crop loss. The following section outlines the major diseases affecting pulses, their symptoms, causes and control measures.

1. Anthracnose: The disease affects all the pulses.

Causal Organism: *Colletotrichum lindemuthianum*

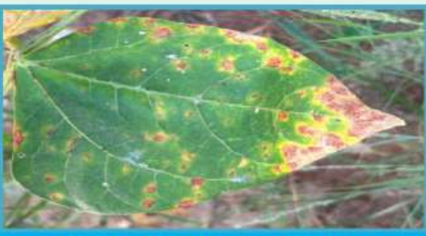
Symptoms: Brown to black sunken lesions appear on the hypocotyl region, leading to seedling death post-emergence. Circular brown sunken lesions with a greyish-white center and dark brown margins develop on leaves and pods. In severe infections, the affected parts wither. Infection soon after germination results in seedling blight.

Epidemiology: The pathogen persists between crop seasons on infected seeds and crop residues. Frequent intermittent rains create favourable conditions for epidemic disease development. The optimal temperature and relative humidity for disease progression are 17–24°C and 100%, respectively. Yield loss ranges from 30-70 %.

Management-

1. Removal of infected plant material/debris and volunteer hosts to reduce the initial inoculum.
2. Seed treatment with carbendazim 50 % WP @ 2 g/kg or mancozeb 50 + carbendazim 25 WS@ 3 g/kg or *Trichoderma harzianum* @ 10g/kg eliminates seed borne infection.
3. Foliar spray with Carbendazim50 % WP@ 1g/l or hexaconazole 5 % SC with first appearance of symptoms on the crop and repeat after 15 days interval

Anthracnose symptoms on mungbean leaf



Anthracnose symptoms on cowpea leaf

Anthracnose symptoms on mungbean pod

2. Macrophomina Blight/Dry Root Rot/Charcoal Rot: The disease affects all the pulses.

Causal Organism: *Macrophomina phaseolina*

Symptoms: It causes root rot, collar rot, seedling blight, stem rot, leaf blight, and pod and seed infections in mungbean, urdbean and cowpea. During the pre-emergence stage, the fungus leads to seed rot and the mortality of germinating seedlings. In the post-emergence stage, seedling blight develops due to soil or seed-borne infections. Initial symptoms include yellowing of leaves, followed by leaf drop. The fungus attacks the stem at the collar region, forming localized dark brown patches that gradually coalesce and eventually encircle the stem. Black, dot-like sclerotia develop on the surface and beneath the epidermis in the outer tissues of the stem and root. Under severe conditions, infected plants wilt within a week.

Epidemiology: Infected seeds serve as a key source of primary inoculum. The disease develops rapidly and causes severe infestations under high temperatures (30–38°C) and water stress conditions. It spreads from plant to plant through rain and irrigation water. Yield loss can go up to 100 % under most favourable conditions.

Management:

1. Removal of infected plant material and use of disease-free seeds of resistant varieties.
2. Soil application of 2.5 kg/ha of T. viride mixed in 500 kg cow dung at the time of sowing and soil drenching with carbendazim 50% WP @ 1.0 g/l at initial appearance of symptoms and at an interval of 15 days.
3. Seeds treatment with Trichoderma @ 10 g/kg of seed or carbendazim 50% WP @ 1.0 g/kg or thiram 75 % WP 2.5g/kg or Tebuconazole 2% DS @ 1.5g/Kg.

Dry root rot in cowpea

Dry root rot in mungbean

Dry root rot in chickpea

3. Yellow Mosaic Disease

Causal Organism: This disease commonly affects mungbean and urdbean and is caused by the mungbean yellow mosaic virus (MYMV), transmitted by the whitefly

Symptoms: The tender trifoliate leaves small scattered yellow to golden colour flecks or mosaic spots that gradually expand, eventually causing complete yellowing. This discoloration reduces flowering and pod formation, while early infections can lead to plant death.

Epidemiology: The incidence and spread of the disease are generally higher in summer and kharif sown crops than in the winter season due to the increased vector population. Dry and warm weather (31–35°C) accelerates virus transmission by the vector. Weed hosts such as *Phyllanthus urinaria, Parthenium hysterophorus, Euphorbia spp.*, and other leguminous plants serve as major sources of primary inoculum. Yield loss can range from 75 to 100 %.

Management

1. Removal of infected plants and weed control.

2. Install yellow sticky traps to monitor and reduce vector population.

3. In order to prevent whitefly (*Bemisia spp.*) infestation spray with dimethoate30% EC @ 1 L/hasoon after the appearance of symptoms and repeat at 15 days interval.

Yellow mosaic symptoms in mungbean

4. Leaf Crinkle: This disease affects mungbean, urdbean and cowpea.

Leaf crinkling in mungbean

Causal Organism: Urdbean leaf crinkle virus (ULCV) belonging to Tospovirus. The virus is transmitted by aphids, whitefly and leaf hoppers and through sap.

Symptoms: Severe leaf crinkling, curling, and puckering, along with stunting, stem thickening, and malformed flowers. Early signs appear as light green discoloration on the third trifoliate leaves, progressing to chlorosis and downward curling. Affected plants show reduced pollen, poor pod formation, and produce shrivelled, light brown seeds, leading to significant yield loss.

Epidemiology: The incidence and spread of the disease by the vector are generally higher at 28–35°C withdry and humidweather accelerates virus transmission and symptom expression. Grain yield loss can range from 2 to 94 %.

Management:

1. Avoid using seeds from diseased crops.
2. Treat seeds with imidacloprid 70% WS @ 5 ml/kg or thiamethoxam 70% WS @ 4 g/kg before sowing.
3. Remove infected plants to prevent contact between healthy and diseased plants during intercultural operations.
4. Apply two foliar sprays of a systemic insecticide dimethoate 30% EC @ 1.5 ml/L or imidacloprid 17.8% SL @ 0.5 ml/L at 30 and 45 days after sowing.

5. Cowpea Mosaic Disease: This disease affects cowpea crop.

Causal Organism: Cowpea mosaic disease is caused by Cowpea mosaic virus (CPMV)

Symptoms: Early symptoms of cowpea mosaic disease include light green mosaic patterns or mottling on young leaves, along with slight curling and distortion of leaf margins. As the disease progresses, affected plants exhibit severe crinkling, puckering, and deformation of leaves. Growth is stunted, with shortened internodes, while chlorotic spots and vein clearing may develop, eventually leading to necrosis in severe cases. Infected plants often produce small, shrivelled, and discoloured seeds, further impacting yield and seed quality.

Epidemiology: CPMV is primarily transmitted by beetles. The virus can also spread mechanically through sap and contaminated farm tools. Environmental factors play a crucial role in disease development, with high temperatures and humidity accelerating virus multiplication. Dense planting and intercropping with susceptible hosts create favourable conditions for disease spread. Yield loss can range from 80-100 %


Cowpea mosaic symptoms

Management:

1. Remove and destroy infected plants to minimize spread.
2. Apply systemic insecticides like imidacloprid 17.8% SL @ 0.5 ml/L or dimethoate 30% EC @ 1.5 ml/L at 15-day intervals to control beetle vectors.
3. Seed treatment with imidacloprid 70% WS @ 5 ml/kg or thiamethoxam 70% WS @ 4 g/kg to prevent early insect attacks.

6. Web Blight: This disease affects urdbean, mungbean and cowpea.

Causal Organism: *Rhizoctonia solani*

Symptoms: The symptoms primarily appear on leaves but can also affect other plant parts, including roots, stems, petioles, and pods. On leaves, small, irregular, water-soaked, pale green spots develop, which later expand, with white mycelial growth visible on the undersurface. On stems, irregular reddish-brown lesions form, gradually enlarging and girdling the stem, ultimately leading to seedling death. In later stages, chestnut-brown microsclerotia develop on affected plant parts. Infected leaves and branches wither, leaving behind a bare main stem. It may cause severe grain yield loss of 25 to 60 %.

Epidemiology: A temperature range of 25–35°C and a relative humidity of 70–90% favor disease development. Rainfall of 95–100 mm during the early stages of crop growth can trigger disease onset. Closer planting further facilitates the spread of the disease to healthy plants.

Management:

1. Treat seeds with *Trichoderma asperellum* @ 5 g/kg, and apply it to the soil along with neem cake (250 kg/ha) and FYM to reduce disease incidence.
2. Apply a foliar spray of Carbendazim 50% WP or Thiophanate Methyl 70% WP @ 1 g/L or Propiconazole 25% EC 1ml/L for effective disease control followed by repetition at 10-12 days interval.


Web blight on mungbean leaves (Early symptoms)


Web blight on urdbean plant (Advanced symptoms)

7. Powdery Mildew: Major problem for urdbean, mungbean and cluster bean crops.

Powdery mildew symptoms in mungbean

Causal Organisms:

- *Erysiphe polygoni* - primarily infects urdbean and mungbean.
- *Leveillula taurica* - mainly affects clusterbean.

Symptoms: The disease first appears as small, irregular white powdery spots, which gradually coalesce to form a white powdery coating on the upper leaf surface and, occasionally, on the lower surface. In advanced stages, the powdery mass turns dirty white, spreading to the pods and stem. Infected leaves become smaller, turn yellow, and eventually wither. The disease accelerates plant maturity, resulting in significant yield losses and shrivelled seeds, with its severity increasing under stress conditions.

Epidemiology: The pathogen overwinters and persists on host tissue or infected plant debris. It thrives in warm, humid conditions (RH 67–90%) with a maximum temperature of 25–30°C and wind speeds of 2.3–4.3 km/h. The disease spreads secondarily through airborne conidia, while rain splash further increases its severity. Yield loss ranges from 40-90% depending on the stage and the occurrence of the disease.

Management:

1. Apply a foliar spray of neem oil (1500 ppm) @ 5 ml/L or *Trichoderma asperellum* @ 5 g/L before disease onset.
2. Foliar spray with carbendazim 50 % WP @ 1g/l or carbendazim 12 % + mancozeb 63 % WP @ 3g/l or karanthane 48% EC @ 0.1 % or tebuconazole 25.9% EC @ 1ml/l, propiconazole 25% EC @ 1ml/L, difenconazole 25% EC @ 1ml/L or azoxystrobin 25% SC @ 1ml/L immediately at initiation of the disease and 10 days later also if necessary.

8. Cercospora Leaf Spot: Mainly affects mungbean, urdbean and cowpea crops.

Causal Organism: *Cercospora canesens*

Symptoms: Characteristic symptoms include leaf spots with a pale brown to grayish center and a reddish-brown border, primarily appearing on the lower leaves. The pathogen also affects petioles, stems, and pods. As the disease progresses, the spots coalesce, forming irregular brown lesions. Under favorable conditions, the spots enlarge, and during flowering and pod formation, severe infection leads to defoliation. Infected plants mature late, resulting in poor pod formation, immature seeds, and reduced yield. It may cause upto 50 percent yield loss.

Epidemiology: The fungus survives on infected seeds and crop debris. The disease is most prevalent during the rainy season, thriving under optimal conditions of 25–30°C temperature and high relative humidity (90–100%), along with dew and dense planting. Secondary spread occurs through airborne conidia, which are further dispersed by rain splashes.

Management:

1. Treat seeds with thiram or captan @ 2.5 g/kg or carbendazim 50% WP@ 2.5 g/kg of seed to prevent early infection.
2. At the first appearance of symptoms, applyfoliar spray of carbendazim 50% WP @ 1.0 g/L or mancozeb 75% WP @ 2.5 g/L or hexaconazole 5% EC @ 1ml/l or propiconazole 25% EC @ 1ml/Lor azoxystrobin 23% SC @ 1ml/l. If necessary, repeat the spray after 10–15 days.


CLS on mungbean leaf


CLS on cowpea leaf

9. **Bacterial Blight:** Affects mungbean, urdbean, cowpea and clusterbean crops.

Causal Organisms:

- *Xanthomonas axonopodis* pv. *phaseoli* — causes blight in mungbean and urdbean.
- *Xanthomonas campestris* pv. *vignicola* — causes blight in cowpea.
- *Xanthomonas axonopodis* pv. *cyamopsidis* — causes blight in clusterbean.

Symptoms: The infection starts as small, water-soaked brown spots on the underside of leaves, progressing to raised, dark lesions. Upper leaf surfaces show dark necrotic spots, which may dry and cause yellowing and early leaf drop. Stems develop reddish, elongated lesions, weakening the plant. Pods show water-soaked, sunken spots with reddish-brown margins. Infected seedlings often have reddish, wrinkled cotyledons. In clusterbean, large angular lesions lead to defoliation and black streaks on plants.

Epidemiology: Rain and wind facilitate the spread of bacteria, while infected seeds serve as a primary means of transmission. Additionally, crop debris and weeds can act as sources of inoculum, contributing to disease persistence and spread. Yield loss may be up to 50 percent.

Management:

1. Implement field sanitation, crop rotation, and destruction of infected crop debris while avoiding weeds near the crop to significantly reduce disease incidence.
2. At the first appearance of symptoms, apply 1 foliar spray of streptocycline @ 1.0 g/10L or copper oxychloride 50% WP @ 2.0 g/L. If necessary, repeat the spray.


Bacterial blight on mungbean


Bacterial blight on cowpea


Bacterial blight on clusterbean

10. Ascochyta blight: This disease affects chickpea crop.

Causal Organism: *Ascochyta rabiei*

Symptoms: Dark circular spots appear on leaves and pods, while elongated lesions develop on stems. These spots are typically surrounded by a brown margin with a yellowish-grey center. On green pods, the circular lesions are bordered by a dark margin and contain pycnidia arranged in concentric rings. On stems and petioles, the lesions are elongated (3–4 cm long), brown in color, and bear numerous black dots. In severe cases, the lesions completely girdle the stem, leading to wilting and drying of the above-ground parts of the plant.

Epidemiology: The primary sources of inoculum are infected seeds, crop debris containing ascospores, and wild relatives of chickpea. Secondary spread occurs via pycnidiospores. The disease can cause up to 100% loss in grain yield and quality. Cool, cloudy, and wet weather, especially with night temperatures around 10°C, day temperatures near 20°C, and prolonged canopy cover, strongly favours disease development and rapid spread.

Management:

1. Seed treatment with carbendazim @ 2g/kg seed.
2. Spray of mancozeb @ 2g/l or copper oxychloride @ 3g/l or wettable sulphur at the initiation of disease followed by repetition of spray 4 times at 10 days interval.

Ascochyta blight on chickpea leaves

Ascochyta blight on chickpea pod

11. Wilt of chickpea and lentil

Causal Organism:

- *Fusarium oxysporum f* sp. *ciceris* (chickpea)
- *Fusarium oxysporum f* sp. *lentis* (lentil)

Symptoms: Wilt symptoms appear as dead seedlings or adult plants, often in patches. Affected seedlings (3–5 weeks old) collapse and lie flat on the ground. Plants show drooping of petioles, rachis, and leaflets—starting from the top and progressing to the entire plant within a day or two. Uprooted plants reveal uneven stem shrinkage (about 2.5 cm) around the collar region. Internal stem tissues show dark brown to black discoloration when split or cut. In case of lentil, necrosis and discolouration on collar region is visible and most of the lateral roots are destroyed.

Wilt in chickpea

Epidemiology: Wilt is a seed- and soil-borne disease, with higher incidence in warmer, drier climates (>25°C) and under continuous cropping without rotation. In India, it causes annual yield losses of 10–15%, rising to 70–100% during severe outbreaks.

Management:

1. Seeds treatment with Trichoderma @ 10 g/kg of seed or carbendazim 50% WP @ 1.0 g/kg or thiram 75 % WP 2.5g/kg
2. Soil application of 2.5 kg/ha of T. viride mixed in 100 kg FYM before sowing.

12. Alternaria Blight of Cluster Bean

Causal Organism: *Alternaria cyamopsidis*

Symptoms: Early infection appears as small, water-soaked spots on leaf blades that enlarge and darken, often showing concentric rings. Lesions may have dark borders and a yellow halo. In humid conditions, spots merge into large blighted areas. Severe cases cause leaf drop, and early infections can hinder flowering and pod formation.

Epidemiology: Alternaria blight is primarily a seed-borne disease, although wind can facilitate the secondary spread of spores. It is favored by warm, humid conditions with temperatures ranging from 25–28°C, high relative humidity, and the presence of continuous rainfall or heavy dew. Under epiphytotic conditions, Alternaria blight can cause yield losses exceeding 55 percent.

Management:

1. Foliar spray with propiconazole 25 EC @ 0.1 % at 30 days after sowing or at the first appearance of symptoms followed by repeated application at 15 days interval.


Alternaria blight of cluster bean


Target board symptoms

References:

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Unit 5

PESTS OF PULSE CROPS: EXTENT OF DAMAGE AND MANAGEMENT

Hansa Jat

Pulses are important crops that provide a major source of protein for millions of people. However, they are often attacked by different types of insect pests during their growth. These pests feed on leaves, flowers, pods and roots, causing serious damage and reducing crop yields. Some pests also spread diseases, making the damage even worse. To protect the crop, it is important to understand the pests, the extent of damage they cause, and how to manage them. This chapter discusses the major pests of pulses and the best ways to control them effectively.

A. Major Pests of Pulses

1. Gram Pod Borer (*Helicoverpa armigera*)

Extent of damage

The Gram Pod Borer (*Helicoverpa armigera*) inflicts significant damage on chickpea crops from the seedling stage through to harvest. Early instar larvae feed by scraping the tender tissues of leaves and shoots. As they develop, second and later instar larvae consume expanding leaves, flower buds and entire flowers. Third instar larvae bore circular holes into pods and feed on developing grains, typically inserting only their heads into the pods while the remainder of their bodies remain outside. Fully mature larvae maintain this feeding behaviour, resulting in conspicuous pod damage. Under severe infestation, complete defoliation of the crop may occur. Nonetheless, chickpea plants exhibit considerable tolerance to early vegetative damage, withstanding up to 60% defoliation without significant yield loss. At the national level, approximately 436 thousand tonnes of chickpea production are estimated to be lost annually due to this pest.

Management

1. Install 5–6 pheromone traps per hectare during January–February or when the adult population is observed to be high for 2–3 consecutive days.
2. Spray Quinalphos 25% EC or Malathion 50% EC @ 1.25 litres/ha, or Monocrotophos 36% SC @ 1.0 litre/ha, at the time of flower setting.
3. Apply neem oil @ 700 ml/ha, or NPV @ 250 LE/ha, or BT @ 1200g/ha, or chlorantraniliprole 18.5% SC @ 0.25 ml/l at the time of 50 percent flowering and repeat after 15 days.
4. Apply chlorantraniliprole 18.5 SC @ 0.25ml/litre after 50% flowering and apply a second spray after 15 days, if required.


Gram Pod Borer Larva


Gram Pod Borer Damage


Gram Pod Borer Adult

2. Spotted Pod Borer (*Maruca vitrata*)

Extent of damage

The larvae cause severe damage to mungbean flower buds and blossoms. A characteristic symptom is the webbing of flowers, pods and leaves, often accompanied by frass, particularly around pod and stem tips. This leads to flower discoloration and shedding. Damaged pods typically exhibit small, dark entry holes where the borers can be found. The webbing often binds leaves and pods together, indicating surface feeding activity. On average, 1.2 larvae per plant are observed, resulting in approximately 10 per cent damage to fruiting bodies and 25 to 40 per cent damage to pods.

Management

1. Spray Quinalphos 25% EC or Malathion 50% EC @ 1.25 litres/ha, or Monocrotophos 36% SC @ 1.0 litre/ha, at the time of flower setting.
2. Apply neem oil 1500 ppm @ 1.5 ml/litre at 30 days after sowing, followed by Chlorantraniliprole 18.5% SC @ 0.20 ml/litre after 10 days.
3. Spray or dust Fenvalerate 0.4% @ 25 kg/ha every 15 days if needed.
4. Spray Indoxacarb 14.5% SC @ 500 ml/ha and repeat after 15 days if necessary.


Spotted Pod Borer Larva


Spotted Pod Borer Adult


Damage by Spotted Pod Borer

B. Sucking Pests of Pulses

1. Whitefly (*Bemisia tabaci*)

Extent of damage

Both adult and nymph whiteflies typically suck sap from the undersides of leaves, reducing the plant's vitality. Severely infested plants become extremely weak, with leaves showing downward cupping and an overall sickly appearance; in extreme cases, the plants may even die. Whiteflies also excrete honeydew, which promotes the growth of sooty mould. This black fungal growth interferes with photosynthesis, further weakening the plant. Under heavy infestations, the entire crop may appear blackened, the leaves may dry out, and complete crop failure can occur. Additionally, whiteflies are vectors of several viral diseases, most notably mungbean yellow mosaic virus (MYMV). MYMV is responsible for the majority of crop losses, as even a small whitefly population is sufficient to transmit the virus.

Whitefly population on the undersurface of leaves

Symptoms of whitefly infestation

2. Thrips (*Caliothrips indicus*), Bagnall

Extent of damage

Thrips cause characteristic damage to pulse crops, particularly during dry spells. Their feeding leads to mottling and silvering of the leaves, as the insects scrape the leaf surfaces and suck out the cell contents. This damage is especially severe in crops like lablab, black gram, green gram and cowpea. As the infestation progresses, the affected leaves dry out, curl and eventually shed prematurely. Severely damaged plants experience stunted growth and fail to develop pods, leading to significant yield losses. In addition to direct feeding damage, thrips also act as vectors for several plant viral diseases, further compounding the impact on crop productivity. High thrips populations under dry weather conditions can lead to widespread crop failure if not managed promptly.

Thrips (*Caliothrips indicus*)

Symptoms of Thrips Damage (Upward Curling of Leaves)

3. Jassid (*Empoasca motti*), Pruthi

Extent of damage

Nymphs and adults of Jassid suck the cell sap from ventral surface of leaves and prolonged feeding causes "Hopper Burn". In which the older leaves below the growing tips burn first. They inject toxin with saliva, induce cell swelling, crush phloem and disrupt movement of photosynthates in plants. As a result of their feeding, the affected parts become yellowish, the leaves wrinkle and curl downwards and are ultimately shed. Besides the feeding, these insects exude honey dew which Favors the development of sooty mould which hinders the photosynthesis of the plant resulting in stunting growth.

Jassid (*Empoasca motti*)

Management of sucking pest:

1. Spray Dimethoate 30% EC @ 1.00 litre/ha for the control of whitefly.
2. Spray Imidacloprid 17.8 SL @ 150 ml/ha or Flonicamid 50% WG @ 200 g/ha in green gram for the control of sucking pests, and repeat after 15 days if needed.
3. Spray *Verticillium lecanii* in cowpea @ 5 ml/l and repeat during the flowering stage for the management of sucking pests.

C. Termite (*Odontotermes obesus*)

Extent of damage

Termites, particularly *Odontotermes obesus,* cause significant damage to plants from the early stages of growth through to the later stages, including both the vegetative and reproductive phases. These pests typically begin to affect plants shortly after sowing, often leading to noticeable damage as the plants grow. Affected plants exhibit symptoms such as drooping leaves, stunted growth and a general weakening of the plant structure. The plants can often be easily uprooted by pulling, revealing termite galleries or feeding wounds on the roots and base of the stem. This damage weakens the plant's ability to absorb nutrients and water, leading to further deterioration. In severe cases, the infestation can result in near-total yield loss, particularly if the attack occurs during the critical early stages of crop development. Timely identification and management of termite infestations are crucial to prevent such extensive damage.

Management

1. Seed treatment with Fipronil 5% SC @ 10ml/kg of seed or Imidacloprid 600 FS @ 5ml/kg of seed at the time of sowing.
2. For areas where the pests are of regular occurrence, the soil should be mixed with Quinalphos 1.5 D or chlorpyriphos 5 D, BHC or 10 D @ 35 kg/ha at the time of sowing.
3. If pest incidence is observed in standing crop, dilute Chlorpyriphos 20EC in 5 litres of water, mix it with 50 kg of soil, and broadcast evenly in 1 ha, followed by light irrigation.

Termite (*Odontotermes obesus*)

D. White Grub (*Holotrichia consanguinea*)

Extent of damage

The White Grub is a polyphagous pest, meaning it feeds on a wide variety of plants. These beetles are commonly known as May-June beetles due to their adult emergence in May or June, which coincides with the onset of the monsoon season. The adult beetles primarily feed on the leaves and underground stems of living plants. However, it is the grubs that cause the most significant damage. The grubs, which are subterranean, actively feed on the living roots of crops and trees such as ber, neem, khejri, shajan, sisam and others. As a result of this root feeding, the affected plants become weak, start to wilt and eventually die. The plants' root systems are severely damaged, and the plants can often be easily pulled out from the soil due to the root loss. The overall health of crops is significantly compromised, leading to reduced yields and, in some cases, complete crop failure if the infestation is severe.

White Grub Beetles

White Grub Beetle Feeding on Leaves

Management

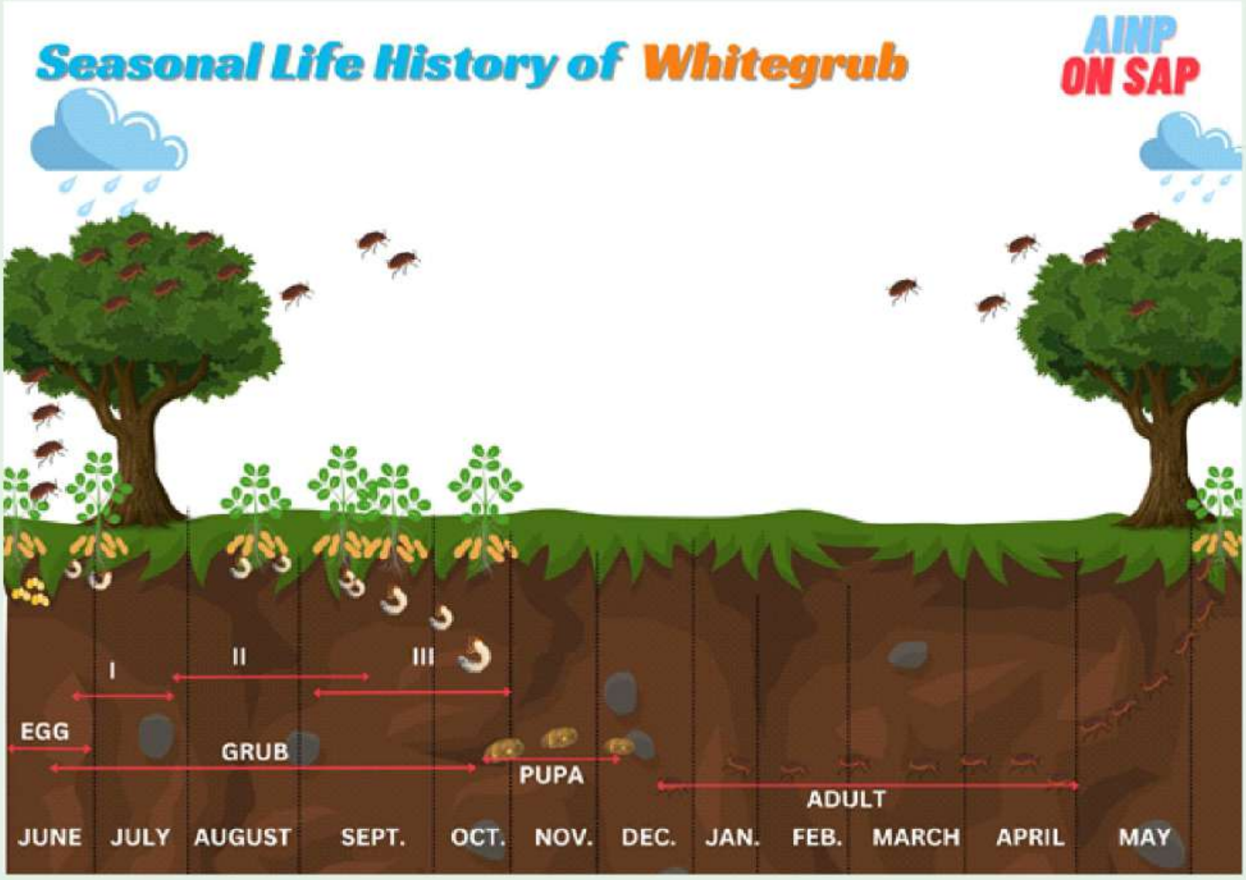
Beetle management: The majority of scarab beetles emerge from the soil following the first significant rainfall event (premonsoon or monsoon) and congregate on preferred host plants. Effective management involves timely application of insecticides, such as **Imidacloprid 17.8 SL** or **Carbaryl (0.2%),** during daylight hours immediately after the initial rainfall. It is imperative that spraying operations are completed within three days of the first shower to eliminate beetles before they oviposit in the soil.

The pheromone **methoxy benzene (anisole),** isolated from the abdominal glands of calling female adults of *Holotrichia consanguinea,* exhibits strong aggregating properties, attracting both male and female beetles from a distance of up to 15 meters. Utilization of this pheromone has significantly enhanced beetle control strategies by making them more efficient, cost-effective, and environmentally safer. Under this approach, it is sufficient to spray only one host tree within a 15-meter radius with insecticide and deploy "Pheromone Dispensers" on it.

For implementation, a single tree among a cluster of host plants within a 15-meter radius should be selected and treated with **Imidacloprid 17.8 SL** or **Quinalphos 25 EC** at a concentration of 1.5 ml/litre during the day. Subsequently, **3–4 pheromone dispensers** should be installed on the selected tree each evening, continuously for three consecutive evenings following beetle emergence. It is critical that no interval occurs between the initial rainfall, insecticide application and pheromone dispenser installation. This integrated procedure should be maintained for 3–4 days after the first emergence of beetles to achieve effective population control.

Grub Management:

1. Treat seeds with Imidacloprid 600 FS @ 6.5 ml/kg of seed or Fipronil 5 SC at 10 ml/kg of seed before sowing.
2. Apply drenching or broadcasting with Imidacloprid 17.8 SL @ 500 ml/ha.



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Unit 6

MAJOR PLANT PARASITIC NEMATODES IN KHARIF PULSES

Hem Raj Gurjar

Plant parasitic nematodes are microscopic worms that cause significant damage to crops, including pulses grown during the kharif season. In kharif pulses such as green gram (mungbean), black gram (urdbean), pigeon pea, cowpea and cluster bean, nematode infestation can lead to stunted growth, yellowing of leaves, reduced pod formation and overall yield loss. Their impact can severely compromise crop health and productivity, making effective management essential for sustaining pulse production during the kharif season.

1. Mungbean

A. Root-Knot Nematodes (*Meloidogyne spp.*)

Effect: Root-knot nematodes induce the formation of galls (swellings) on plant roots, disrupting the uptake of water and nutrients. This leads to stunted plant growth, yellowing of leaves and significantly reduced yields.

Symptoms: Presence of root galls, poorly developed root systems, stunted growth and leaf yellowing.

General Symptoms of Root-Knot Nematode (RKN) in Mungbean

Mungbean Roots Infected by Root-Knot Nematode (RKN)

B. Lesion Nematodes (*Pratylenchus spp.*)

Effect: Lesion nematodes feed on root tissues, causing the formation of dark lesions. Their activity weakens the plant, deteriorates root health, and hampers nutrient absorption.

Symptoms: Dark root lesions, poor root development, and stunted plant growth.

C. Reniform nematodes (*Rotylenchulus reniformis*)

Effect: Reniform nematodes infect plant roots, impairing root function and leading to poor plant growth and reduced yields. Two races, Race A and Race B, are commonly found in India, including Rajasthan.

Symptoms: Yellowing of leaves, stunted growth and damaged roots.

2. Blackgram (*Uradbean*)

A. Root-Knot Nematodes (*Meloidogyne spp.*)

Effect: A major pest that causes root galling, damaging the root structure and reducing nutrient uptake, ultimately leading to poor plant growth.

Symptoms: Gall formation on roots, stunted plants, poor flowering and reduced pod formation.

B. Lesion Nematodes (*Pratylenchus spp.*)

Effect: These nematodes feed on root tissues, creating lesions that impair the plant's ability to absorb water and nutrients, resulting in poor growth.

Symptoms: Stunted growth, root lesions and yellowing of leaves.

Roots severely damaged by Meloidogyne javanica (Root-knot nematode) infection, showing prominent gall formation

C. Cyst Nematodes (*Heterodera spp.*)

Effect: Cyst nematodes form cysts on the roots, leading to nutrient deficiencies and stunted plant development.

Symptoms: Root swelling, yellowing of leaves and reduced yields.

3. Pigeonpea

A. Root-knot Nematodes (*Meloidogyne spp.*)

Effect: A significant pest that causes gall formation on the roots, impairing the plant's ability to absorb water and nutrients, leading to stunted growth.

Symptoms: Root galls, stunted growth, reduced pod formation, and yellowing of leaves.

B. Cyst Nematodes (*Heterodera spp.*)

Effect: These nematodes form cysts on the roots, resulting in plant stunting and poor development.

Symptoms: Yellowing of leaves, stunting and poor pod development.

C. Lesion Nematodes (*Pratylenchus spp.*)

Effect: These nematodes attack the root cortex, causing lesions that reduce nutrient uptake and deteriorate plant health.

Symptoms: Lesions on the roots, stunted growth and wilting.

D. Reniform Nematodes (*Rotylenchulus reniformis*)

Effect: These nematodes infest the roots, weakening the plant and inhibiting its growth.

Symptoms: Yellowing of leaves, poor growth and damaged roots.

4. Cowpea

A. Root-knot Nematodes (*Meloidogyne spp.*)

Effect: A major issue for cowpea, root galling severely hampers the root's ability to absorb nutrients and water, resulting in poor growth and reduced yields.

Symptoms: Galled roots, stunted growth and yellowing of leaves.

Raising awareness about Root-knot Nematode (RKN) infestation in cowpea

Mature females of Root-knot Nematodes (RKN) on cowpea roots

B. Lesion Nematodes (*Pratylenchus spp.*)

Effect: These nematodes damage the roots by feeding on root tissues, leading to reduced plant vigour and growth.

Symptoms: Root lesions, wilting and poor root development.

C. Reniform nematodes (*Rotylenchulus reniformis*)

Effect: These nematodes weaken the plant by attacking the root system, resulting in reduced growth and yield.

Symptoms: Stunted growth, yellowing of leaves, and poor root development.

5. Cluster Bean (Guar)

A. Root-knot Nematodes (*Meloidogyne spp.*)

Effect: These nematodes cause gall formation on roots, disrupting nutrient and water uptake, which leads to stunted growth.

Symptoms: Root galls, poor root development and yellowing of leaves.

B. Lesion Nematodes (*Pratylenchus spp.*)

Effect: Lesion nematodes attack the root system, causing lesions that impair the plant's ability to absorb nutrients, resulting in stunted growth.

Symptoms: Root lesions, stunted growth and yellowing of leaves.

C. Reniform nematodes (Rotylenchulus reniformis)

Effect: Damage to the roots by these nematodes reduces both plant growth and yield.

Symptoms: Stunted growth and yellowing of leaves.

6. Groundnut (Peanut)

A. Root-knot Nematodes (*Meloidogyne spp.*)

Effect: One of the most damaging nematodes for groundnut, causing root galling, stunting and poor peanut development.

Symptoms: Gall formation on roots, stunted growth and reduced pod formation.

B. Cyst Nematodes (*Heterodera spp.*)

Effect: These nematodes damage the roots, hindering the plant's ability to absorb nutrients and leading to poor growth.

Symptoms: Yellowing of leaves and poor pod formation.

C. Lesion Nematodes (*Pratylenchus spp.*)

Effect: Lesion nematodes feed on the roots, creating lesions that reduce the plant's growth and yield potential.

Symptoms: Root lesions, yellowing of leaves and poor pod development.

D. Reniform Nematodes (*Rotylenchulus reniformis*)

Effect: These nematodes attack the roots and disrupt nutrient uptake, leading to stunted growth and reduced yields.

Symptoms: Yellowing of leaves and stunted plants.

7. Soybean

A. Root-knot Nematodes (*Meloidogyne spp.*)

Effect: These nematodes cause root galls, which stunt plant growth and severely reduce yield.

Symptoms: Gall formation on roots, yellowing of leaves and poor pod formation.

B. Cyst Nematodes (*Heterodera spp.*)

Effect: These nematodes infest the roots, leading to cyst formation and nutrient deficiencies, which hinder the plant's growth and productivity.

Symptoms: Root swelling, yellowing of leaves and stunted growth.

C. Lesion Nematodes (*Pratylenchus spp.*)

Effect: Lesion nematodes damage the root system, reducing its ability to absorb nutrients, thereby affecting plant health.

Symptoms: Root lesions, stunted growth and wilting.

D. Reniform Nematodes (*Rotylenchulus reniformis*)

Effect: These nematodes attack the roots, leading to poor growth and reduced yields in soybean crops.

Symptoms: Yellowing of leaves and reduced growth.

Nematode Management Strategies

To effectively manage plant-parasitic nematodes, consider implementing a combination of the following strategies:

7.1 Crop rotation: Alternate pulses with non-host crops (like cereals) to break the nematode life cycle.

7.2 Biological control: Use biological agents like Paecilomyces lilacinus (Purpureocillium lilacinum), Pseudomonas fluorescens and Trichoderma spp., which are known to help control nematode populations.

7.3 Nematicides: Though chemical nematicides are available, they should be used judiciously due to environmental concerns and high costs. Examples include: Carbofuran 3G @ 1.5 Kg a.i./ha., Fluensulfone 2% GR @ 20 Kg/ha.

7.4. Organic practices: Use organic amendments like neem cake @ 10 quintals/ha and bio-pesticides to help manage nematodes without harming the soil ecosystem.

7.5 Soil solarization: Use a 25-micron transparent polythene sheet during the May-June months for 21 days. This method involves using solar heat to kill nematodes in the soil before planting.

7.6 Deep summer ploughing: Perform 2-3 deep summer ploughings during May-June to reduce the nematode population in the soil.

Deep Summer Ploughing

Soil Solarization

Use of Bio-agents

Unit 7

CROP PRODUCTION PRACTICES FOR MAJOR PULSES

Anju K. Khangarot, Shweta Gupta & R. N. Choudhary

Crop production practices in pulses involve careful land preparation, timely sowing and proper crop spacing to ensure good plant growth and yield. Nutrient management in pulses emphasizes the use of organic manures and balanced application of phosphorus and micronutrients, as these crops fix atmospheric nitrogen through symbiosis with Rhizobium bacteria, reducing the need for nitrogen fertilizers. Seed inoculation with Rhizobium enhances nitrogen fixation and improves plant vigor. Weed management is crucial during the early growth stages, typically the first 30–45 days, and involves methods such as pre-sowing tillage, manual or mechanical weeding, and the use of selective herbicides like pendimethalin or imazethapyr. Integrated approaches combining cultural, mechanical, and chemical methods help maintain weed-free fields and support healthy pulse production. Pulse cultivation is mostly done under rainfed conditions.

During the Kharif and Rabi season, pulses such as moong (green gram), moth bean, urad (black gram), cowpea, arhar (pigeon pea), gram (chickpea), masoor (lentil) and matar (field pea) are commonly cultivated. These leguminous crops play a vital role in enhancing soil fertility. Their roots harbor beneficial bacteria (Rhizobium species) that fix atmospheric nitrogen, converting it into a form that plants can absorb. This natural process enriches the soil with essential nutrients, reducing the need for chemical fertilizers. Including pulses in the crop rotation not only sustain but also improves soil health and long-term agricultural productivity.

7.1 Field Preparation

After rainfall, for proper crop cultivation, the field should be plowed once or twice as per the requirement to prepare the soil. During the final preparation, it is important to ensure that the land is well-leveled and that there is proper drainage. This helps prevent water logging and creates an ideal environment for seed germination and healthy crop growth.

7.2 Seed Rate and Sowing Time

Table 7.1: Seed Rate and Sowing Time for Different Pulse Crops

S. No.	Crop	Seed Rate (kg/ha)	Sowing Time (India)	Spacing (Row × Plant, cm)	Remarks
1	Mung bean	15–20	*Kharif*: June–July *Summer*: March	30 × 10	Summer crop needs irrigation
2	Urd bean	12-15	*Kharif*: June–July	30 × 10	Short-duration crop
3	Lentil	60	*Rabi*: October–November	30 × 15	Grown in northern plains
4	Gram (Chickpea)	60-70 (Desi medium) 90-100 (Kabuli large)	*Rabi*: October–November	30 × 10–15	Kabuli needs higher seed rate
5	Cowpea	15–20	*Kharif*: June–July *Summer*: March	30–45 × 10–15	Also used as fodder crop
6	Clusterbean (Guar)	15–20	*Kharif*: June–July	30× 10	Drought-tolerant crop
7	Moth bean	10	*Kharif*: July	45 × 15-20	Suited for arid and semi-arid regions

7.3 Nutrient Management in Pulses

Seed Treatment with Bio-fertilizer: For effective seed treatment in pulses, Rhizobium and Phosphate-Solubilizing Bacteria (PSB) are commonly used bio-fertilizers. For 1 hectare, use 600 grams of Rhizobium and 600 grams of PSB. Mix each with a small amount of water or 10% jaggery solution to form slurry. Coat the required quantity of seeds evenly, and then dry them in the shade before sowing. Rhizobium helps fix atmospheric nitrogen in the root nodules, while PSB makes soil phosphorus available to the plants. This treatment enhances soil fertility, promotes healthy crop growth, and reduces the need for chemical fertilizers.

Organic Manure and Fertilizer:

Farmyard Manure (FYM) or Compost: Apply 5 to 10 tons per hectare (5000–10,000 kg/ha). Incorporate it into the soil 2–3 weeks before sowing to improve soil structure, moisture retention, and microbial activity.

Vermi-compost (Optional/Additional): Use 1–2 tons per hectare if available. It's nutrient-rich and enhances root development and early plant growth.

Table 7.2: Recommended Dose of Fertilizer

S.No.	Crop	Nitrogen (N)	Phosphorus (P_2O_5)	Potassium (K_2O)
1.	Mung bean	10-15 kg	30-40 kg	20 kg (if needed*)
2.	Urd bean	10-15 kg	30-40 kg	20 kg (if needed*)
3.	Lentil	15-20 kg	40 kg	20 kg (if needed*)
4.	Gram (Chickpea)	20 kg	40 kg	20 kg
5.	Cowpea	10-15 kg	30-40 kg	20 kg (if needed*)
6.	Clusterbean	10 kg	40 kg	20 kg

*Based on soil test values

In pulse cultivation, the application of micronutrients like iron (Fe) and zinc (Zn) should be guided by soil test results for optimal effectiveness. If soil show zinc deficiency, it is recommended to apply 25 kg per hectare of Zinc Sulphate as a basal dose at sowing. Similarly, if iron levels are low, 50 kg per hectare of Ferrous Sulphate should be applied. These micronutrients play a vital role in enzymatic activities, chlorophyll synthesis, and overall plant growth. For areas with severe deficiency, foliar sprays of 0.5% $ZnSO_4$ or $FeSO_4$ can also be used during the vegetative stage to quickly correct deficiencies. Balanced micronutrient management based on soil testing improves yield, nutrient use efficiency, and soil health in pulses.

In areas with sulphur deficiency, 20 kg of sulphur or 150 kg of gypsum can be applied to correct the deficiency as well as it also improves soil fertility.

Mungbean

- A foliar spray of 2% NPK (18:18:18 or 19:19:19) solution can be applied at the time of flowering to enhance growth and yield.
- For organic farming, it is recommended to apply 3 tonnes of farmyard manure (FYM) or 1.5 tonnes of vermin-compost along with 5 kg per hectare of phosphate-solubilizing bacteria (PSB).

Cowpea:

- In rainfed cowpea crop, spraying a 2.5% urea solution at 25–30 days after sowing increases seed yield and net returns.

Clusterbean

- In clusterbean, two foliar sprays of 1% NPK (19:19:19) solution is recommended at 45 and 65 days after sowing to enhance growth and yield.
- In rainfed areas, 2 foliar sprays of 1% urea solution at 35-45 DAS (before flowering emergence) and 55-60 DAS (after flowering emergence) is recommended.
- With the application of RDF clusterbean seeds can also be treated with liquid microbial consortium @ 3-5 mg/kg seed and 4-5 lit/ha FYM or vermicompost at the time of sowing.

Gram

- Before sowing application of 5 kg hydrogel application followed by two foliar spray of 0.5% NPK (19:19:19) solution is recommended at pre-flowering (65-70 DAS) and pod formation (85-90 DAS) stages to enhance growth, yield and net returns.
- In rainfed areas, 2 foliar sprays of 2% DAP or 2% urea solution at pre flowering and after 10 days of first spray is recommended.
- For organic cultivation of gram, it is recommended to apply 5 t/ha of farmyard manure (FYM) treated with phosphorus and sulphur is recommended. This is followed by a foliar application of 20% liquid bio-fertilizer at 40 days after sowing (DAS), along with two additional sprays at 15-day intervals after the first application.

Lentil

- One foliar spray of 2% urea solution at flowering stages is recommended to enhance the growth and yield.
- To achieve higher yields in lentil, apply 1 kg of boron per hectare at the time of sowing and spray a 400-ppm boron solution at the flowering stage.

7.4 Weed Management in Pulses

Pulses (such as chickpea, lentil, black gram, green gram, etc.) are poor competitors with weeds, especially during the initial growth stages. Weed Management in Pulses is crucial to ensure optimal crop growth, improve yield, and reduce competition for nutrients, water, and light. Effective weed management strategies for pulses include both cultural and chemical methods.

7.4.1 Agronomical Practices for Weed Management in Pulses

Table 7.3: Agronomical Practices for Weed Management in Pulses

S. No.	Practice	Benefit	Example
1	Crop Rotation	Breaks weed cycles	Chickpea → Wheat → Mungbean
2	Intercropping	Canopy closure, light suppression	Pigeon pea + Green gram
3	Optimum Plant Spacing	Reduces space for weeds	Chickpea with 30 cm row spacing
4	Timely Sowing	Gives crop a head start	Black gram just after first rains
5	Field Preparation/Tillage	Kills weed seeds and rhizomes	Deep ploughing in summer
6	Mulching	Prevents weed seed germination	Straw mulch in lentil fields
7	Water & Nutrient Management	Localized resource use favors crops	Drip irrigation in pigeon pea
8	Smother Crops	Outcompete weeds quickly	Cowpea before lentils
9	Weed-Suppressive Varieties	Early vigor reduces weed growth	(Emerging research)
10	Clean Farming / Sanitation	Prevents seed spread	Clean bunds, remove field edge weeds

7.4.2 Chemical Methods for Weed Management in Pulses

Mungbean

• Pre-emergence application of Pendimethalin 30 EC + Imazethypr 2 EC (Ready-mix) @ 750 g a.i./ha is recommended for the weed management in greengram.

• In standing mungbean crop, to control broadleaf and grass-type weeds, a spray of Imazethypr @ 40 g a.i./ha at 15–20 days after sowing is recommended.

• For the effective management of weeds in the greengram crop, post-emergence application of Sodium Acifluorfen 16.5% + Clodinofop-Propargyl 8% EC (Ready mix) @ 245 g a.i./ha or Fluzifop-p-butyl 13.4% + Fomesafen 11.1% @ 245 g a.i./ha (Ready mix) at 15-20 DAS in 500 litres of water is recommended.

Cowpea

• Pre-emergence application of Pendimethalin 30 EC @ 750 g a.i/ha + One Interculture operation at 20-25 DAS is recommended for the effective weed management in cowpea.

- In standing cowpea crop, to control broadleaf and grass-type weeds, a spray of Imazethypr 10% SL 37.5 g or Imazethapyr + Imazamox 70 WDG @ 40 g a.i. /ha at 15–20 days after sowing is recommended.

Clusterbean

- Pre-emergence application of Pendimethalin 30 EC @ 0.75 kg a.i/ha + One Interculture operation at 20-25 DAS is recommended for the effective weed management in clusterbean.
- A spray of Imazethypr 10% SL 37.5 g or Imazethapyr + Imazamox 70 WDG @ 40 g a.i. /ha at 15–20 days after sowing is also recommended for effective weed management in clusterbean.
- After sowing with zero tillage machine a pre-emergence application of Pendimethalin 30 EC + Imazethypr 2 EC (Ready-mix) @ 1 kg a.i./ha is recommended for the weed management in clusterbean.
- Post emergence application of Sodium propaquizafop 2.5 % and Imazethapyr 3.7 % herbicide mixture @ 125 g a.i. /ha at 15–20 days after sowing is recommended in clusterbean.

Gram

- Pre-emergence application of Pendimethalin 30 EC @ 750 g a.i/ha or Pendimethalin 38.7 CS @ 750 g a.i/ha is recommended for effective weed management.
- A pre-emergence application of Pendimethalin 30 EC + Imazethypr 2 EC (Ready-mix) @ 200 g a.i./ha is recommended for the management of wild onion.

Lentil

- Post emergence application of Quizalofop ethyl 10% EC @ 50 g a.i/ha at 30 days after sowing is recommended.

Common Broad Leaf Weeds in Pulses

S. name: *Verbesina encelioides*
C. name: *Golden Crownbeard*
Family: **Asteraceae**

S. name: *Chenopodium album*
C. name: *Lamb's Quarters*
Family: Chenopodiaceae

S. name: *Portulaca oleracea*
C. name: *Common Purslane*
Family: Portulacaceae

S. name: *Sonchus oleraceus*
C. name: *Sowthistle*
Family: Asteraceae

S. name: *Tridax procumbens*
C. name: *Tridax*
Family: Asteraceae

S. name: *Solanum nigrum*
C. name: *Black Nightshade*
Family: Solanaceae

Common Broad Leaf Weeds in Pulses

S. name: *Amaranthus spinosus*
C. name: *Spiny Amaranth*
Family: Amaranthaceae

S name: *Amaranthus viridis*
C name: *Slender Amaranth*
Family: Amaranthaceae

S name: *Ipomoea indica*
C name: *Morning Glory*
Family: Convolvulaceae

S name: *Rumex dentatus*
C name: *Indian Dock*
Family: Polygonaceae

S name: *Celosia argentea*
C name: *Cockscomb*
Family: Amaranthaceae

S name: *Eclipta alba*
C name: *False Daisy*
Family: Asteraceae

S name: *Cynodon dactylon*
C name: *Bermuda grass*
Family: Poaceae

S name: *Cyperus rotundus*
C name: *Purple nutsedge*
Family: Cyperaceae

S name: *Eleusine indica*
C name: *Indian goosegrass*
Family: Poaceae

S. name: *Poa annua*
C. name: *Annual bluegrass*
Family: Poaceae

S. name: *Avena ludoviciana*
C. name: *Winter Wild Oat*
Family: Poaceae

S name: *Dactyloctenium spp.*
C. name: *Crowfoot Grass*
Family: Poaceae

Common Broad Leaf Weeds in Pulses

S. name: *Sorghum halepense*
C. name: *Johnson grass*
Family: Poaceae

S. name: *Digitaria sanguinalis*
C name: *Crabgrass*
Family: Poaceae

S. name: *Megathyrsus maximus*
C name: *Guinea grass*
Family: Poaceae

S. name: *Asphodelus tenuifolius*
C name: *Wild onion*
Family: Asphodelaceae

S. name: *Phalaris minor*
C. name: *littleseed canarygrass*
Family: Poaceae

S. name: *Lepidium didymum*
C. name: *Swinecress*
Family: Brassicaceae

Unit 8

EXPANDING THE REACH OF PULSES IN RAJASTHAN

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Pulses are essential for sustainable agriculture in Rajasthan, especially in its rain-fed and arid regions. Their ability to grow in low-input conditions and enrich soil fertility makes them crucial for crop diversification and food security. However, challenges like drought stress, poor seed availability and high labour costs have limited their expansion. This chapter outlines key strategies to enhance pulse cultivation in Rajasthan, including the development of short-duration and stress-tolerant varieties, improved seed systems, mechanization, better agronomic practices, post-harvest management, market support, timely input delivery and effective technology transfer.

8.1 Development of Varieties

8.1.1 Short duration varieties

The crop maturity duration to available cropping window, including soil moisture availability, is a major strategy to avoid drought stress in the rain-fed conditions of Rajasthan. Hence, crop improvement programs have emphasized developing high-yielding, short-duration cultivars that escape terminal drought conditions. These short-duration varieties provide opportunities to include a crop/ variety in the cropping systems. The development of short-duration and wilt-resistant varieties has led to the adoption of pulses in new niches of the eastern part of Rajasthan, To increase pulse area and production in rain-fed and arid regions of Rajasthan, some key factors like (i) Introduction of high-yielding, short duration, wilt-resistant varieties will be adopted; (ii) High adoption of improved varieties and production technologies among the farmers; (iii) Effective management of pod-borer; and (iv) Availability of grain storage facilities to farmers at the local level at affordable cost.

8.1.2 Varieties for Biotic and Abiotic stress tolerance

The Biotic and Abiotic stress tolerant varieties can provide cost-effective long-term solutions against adverse effects of climate change. A wider dissemination of biotic and abiotic stress-tolerant material would provide sustenance to the livelihoods of farmers who are more vulnerable to shocks of crop failure.

8.2 Robust Seed System

Various improved pulse varieties were released by the Central Varietal Release Committee and state Varietal Release Committee for cultivation despite a long list, and the farming community has not fully realized their impact of popularity. The unavailability of quality seeds of improved pulse varieties for smallholder farmers is a major constraint to improving the cultivable area of pulses in Rajasthan. Generally, the pulse seed business does not attract large seed companies because profit margins are low. The informal seed system supplies most pulses, so the seed replacement rate in Rajasthan is very low. Thus, this indicates that a majority of the farmers still use their own saved seed. This situation is due to several factors, including legumes' low seed multiplication rate, the reuse of grains from previous harvests as seeds, and the frequent demand for specific varieties adapted to more narrow agroecology and consumers' needs.

On-farm minikit trials and demonstrations of newly released varieties will be conducted at the village or block levels to popularize the variety among the farming community. This approach will help farmers adopt newly released varieties and strengthen the seed replacement rate of pulses.

The partnership between public and private seed agencies, commonly known as an integrated seed system, would be the best approach to increase the availability of quality seed legumes.

8.3 Mechanization

The developed countries use mechanical harvesting of pulses. Still, in India and Rajasthan, most pulses are harvested by hand because major pulse varieties are not suited for mechanical harvesting. Harvesting by hand continuously increases labour costs and becomes an expensive field operation for pulses. The farmers are interested in opting for mechanical harvesting where it is feasible. The farmers are demanding pulse varieties suited to mechanical harvesting. The availability of varieties suited to mechanical harvesting will reduce production costs and attract farmers towards increased pulse cultivation in Rajasthan.

8.4 Good Agronomic Practices

Good agronomic practices where the cost of cultivation can be reduced substantially promote the use of post-emergence herbicides in controlling weeds by developing herbicide-tolerant varieties. Generally, pulses are sensitive to herbicides, and manual weeding is currently the only option for weed control. Managing weeds in pulses is becoming expensive and, in some cases, uneconomical due to the high labour cost involved in manual weeding. Herbicide-tolerant cultivars offer the opportunity to control weeds through need-based applications of herbicides. Weed management through herbicides is economical and facilitates zero-tillage or minimum-tillage methods.

8.5 Reducing post-harvest losses

The post-harvest losses are reduced through the refinement and popularization of harvesters, threshers and graders; development of stored grain pest-resistant varieties; popularization of low-cost safe storage bins/structures/ processing units; strengthening of FPOs.

8.6 Ensuring attractive price to producers

Announcement of MSP well in advance; assured procurement and creation of procurement centres in production zones; development of organized markets for pulses; linking farmers with FPOs, aggregations and e-NAM (markets); promotion of export of pulses like lentil and kabuli chickpea and arid legumes; production of value-added products and use of by-products; branding of produce and promotion of organic pulse production.

8.7 Ensuring timely availability of critical inputs and advisory

Ensuring timely availability of quality bio-pesticides; creation and maintenance/sustain of production units of quality bio-fertilizers and bio-pesticides; fortification of fertilizers with specific nutrients like S, Fe, Zn, B, etc.; popularization of sprinklers and micro-irrigation techniques in rainfed areas; establishment of single window input supply centres for a cluster of villages; advanced forewarning and forecasting systems for pest and disease outbreaks.

8.8 Efficient transfer of technology

Organizing farmer's training in KVKs, exposure visits & close interaction with research organizations ARSs, SAU and private agencies; initiatives for seed production to exploit the high demand for improved varieties of pulses as well as branding of local germplasm: exploiting the led commercial pulse processing units at village level etc.

References :

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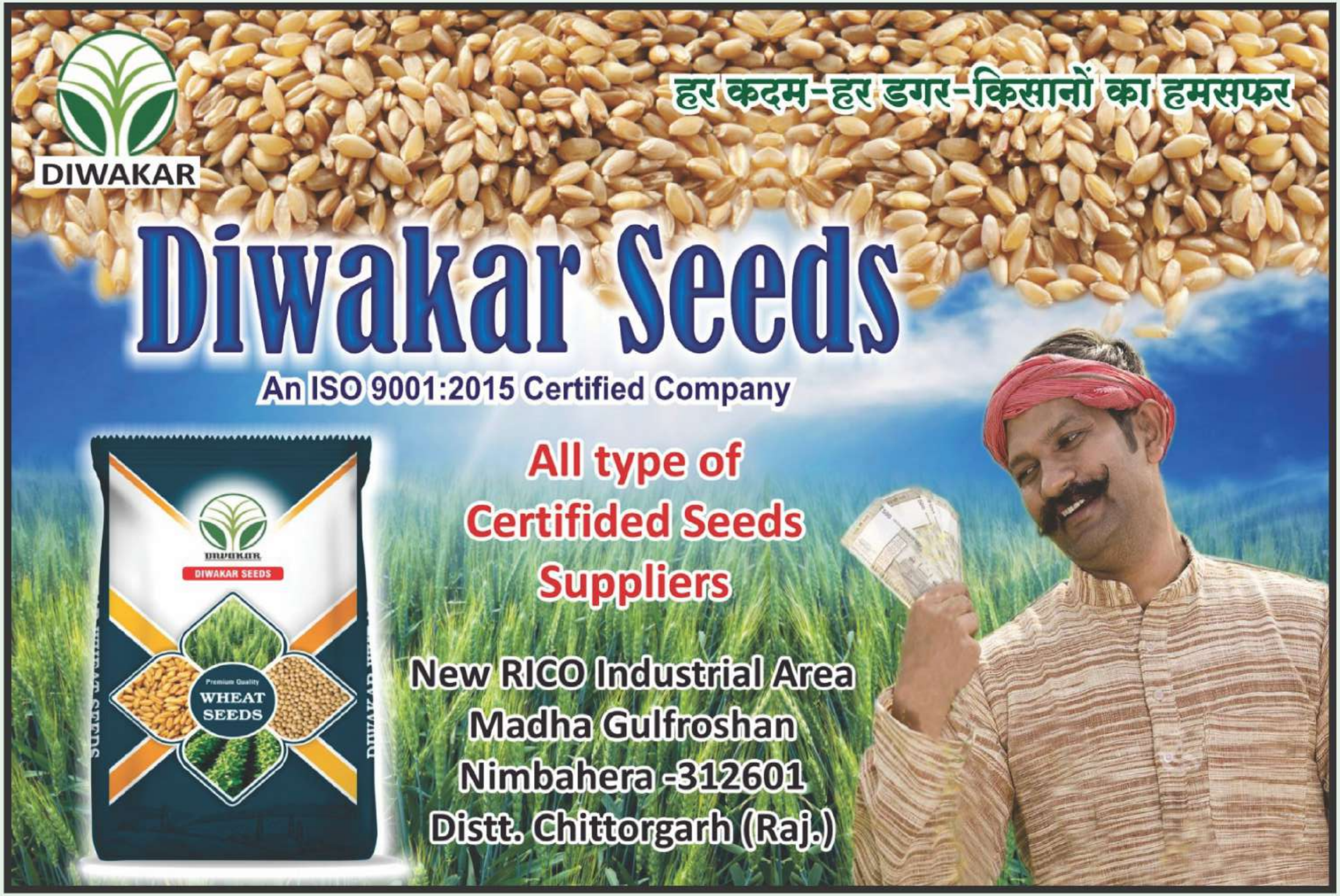
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Historical / Glorious Achievements of SKNAU, Jobner

- First Triple dwarf wheat in India : Lal Bahadur (1971)
- First salinity tolerant wheat in India : Kharachia 65 (1974)
- A wonder wheat (Suitable for timely, late & saline conditions) : Raj 3077 (1989)
- India's first heat tolerant wheat : Raj 3765 (1996)
- India's first CCN resistant wheat : Raj Molya Rodhak 1 (2011)
- India's first Ug 99 (stem rust race) resistant wheat : Raj 4120 (2009)
- First dwarf barley mutant in world: RDB-1 (1974)
- First salinity tolerant barley in India: Bilara-2 (1980)
- First nematode resistant barley in India: Rajkiran (1982)
- India's first dual purpose barley: RD-2715 (2009)
- Barley variety with highest yield potential in India : RD 2035 (1994)
- A unique barley: RD-2552 (2000)
  (Suitable for irrigated/rainfed/saline-alkaline conditions & green fodder purpose)
- Rajsthan's first two rowed malt barley: RD-2668 (2007)
- Malt barley with excellent malting / brewing quality: RD-2849 (2016)
- Drought tolerant hybrid of pearl millet: RHB 177 (2011)
- Biofortified hybrid of pearl millet: RHB 233 & RHB 234 (2019)
- Early maturing cluster bean variety : RGC 936 (1994)
- First white seeded cowpea variety: RC 101 (1987)
- First rainfed double podded chickpea variety: RSG 888 (2003)
- First kabuli chickpea variety in the state: RSGK 6 (2003)
- First double podded variety of chickpea: CSJD 884 (2003)
- First late sown chickpea variety : RSG 963 (2005)
- First white flowerd variety of chickpea: RSG 895 (2005)
- First rainfed as well as irrigated chickpea variety: RSG 931 (2006)
- Salinity tolerant variety of chickpea; RSG 896 (2007)
- First green seeded variety of chickpea: RSG 991 (2007)
- Extra large seeded Kabuli chickpea: CSJK 21 (2013)
- Green fleshed, sweet with pleasant fragrance muskmelon variety:
  Durgapura Madhu (1997)
- Water melon variety: Durgapura Lal (2004)
- First copper-red, mild pungent onion variety of the state: RO 1 (2004)

Milestone Varieties Developed by SKNAU

Wheat

Raj 3077	1989	Wonder Wheat: Suitable for Saline/Alkalne, Timely Sown and Late Sown
Raj 3765	1996	Heat Tolerant Wheat and Suitable for Late Sown
Raj 4037	2004	Highest Breeder Seed Indented Variety of Wheat
Raj 4120	2009	Resistant to All three rusts and Bio fortified with Fe and Zn
Raj MR 1	2011	Cereal Cyst Nematode Resistant Wheat
Raj 4238	2016	High Yielding Variety Good for Chappati Quality

Barley

RDB 1	1974	India's first semi Dwarf mutant Barley
BL 2	1980	India's First Salinity and alkalinity tolerant variety
Raj Kiran	1982	India's First Cereal Cyst Nematode Resistant Barley
RD 2715	2009	India's First Dual Purpose Barley Variety
RD 2849	2016	Malt Barley with High Yield and Excellent Malting/Brewing Quality
RD 2899	2018	Feed Barley with High Yield and Resistant to Rust Diseases

Clusterbean

RGC 1066	2007	Also Known as Lathi, Unbranched Variety Suitable for mixed cropping
RGC 1038	2009	Suitable for semi-arid, sandy loam soils and rain-fed condition
RGC 1033	2011	Medium maturity (100-105 days), branched with medium height with good grain yield potential (12.71 to 26.85 qt./ha).
RGr 12-1	2018	Early maturing (87 days), moderately resistance to bacterial blight and Alternaria leaf spot
RGr 18-1	2022	Medium maturity (90-95 days), moderately resistance to bacterial blight and Alternaria leaf spot with yield potential of 15.0q/ha
CPD 119	2018	Cow Pea Variety, Medium bold (9.11 gm) white seeded variety and mature in 70 days with seed yield of 6.0-8.0q/ha.

Milestone Varieties Developed by SKNAU

Chickpea

RSG-888 — 2003 — Drought tolerant

RSG-807 — 2006 — Bold seeded

RSG-991 — 2007 — Green seeded for processing

RSG-974 — 2012 — Late sown, frost tolerant

CSJ-515 — 2016 — Mechanical harvesting Suitable for rain fed areas

CSJK 174 — 2021 — Bold Seeded Kabuli Early maturity

Pearlmillet

2011 — **RHB 173**
Suitable for Arid region
Medium maturity (78-80 days).

2011 — **RHB 177**
Thin stem is advantageous for fodder purpose

2018 — **RHB 223**
Early maturity (71days)
Resistance to downy mildew and blast

2019 — **RHB-233**
Biofortified - High iron (83 ppm) and high Zinc (50 ppm)

2019 — **RHB 234**
Dual purpose hybrid
Biofortified - High iron (84 ppm) and high Zinc (41 ppm)

2021 — **RHB-228**
Stae Released Hybrid

Groundnut

2012 — **RG 510**
Resistant to collar rot, stem rot, early leaf spot, rust and stem necrosis

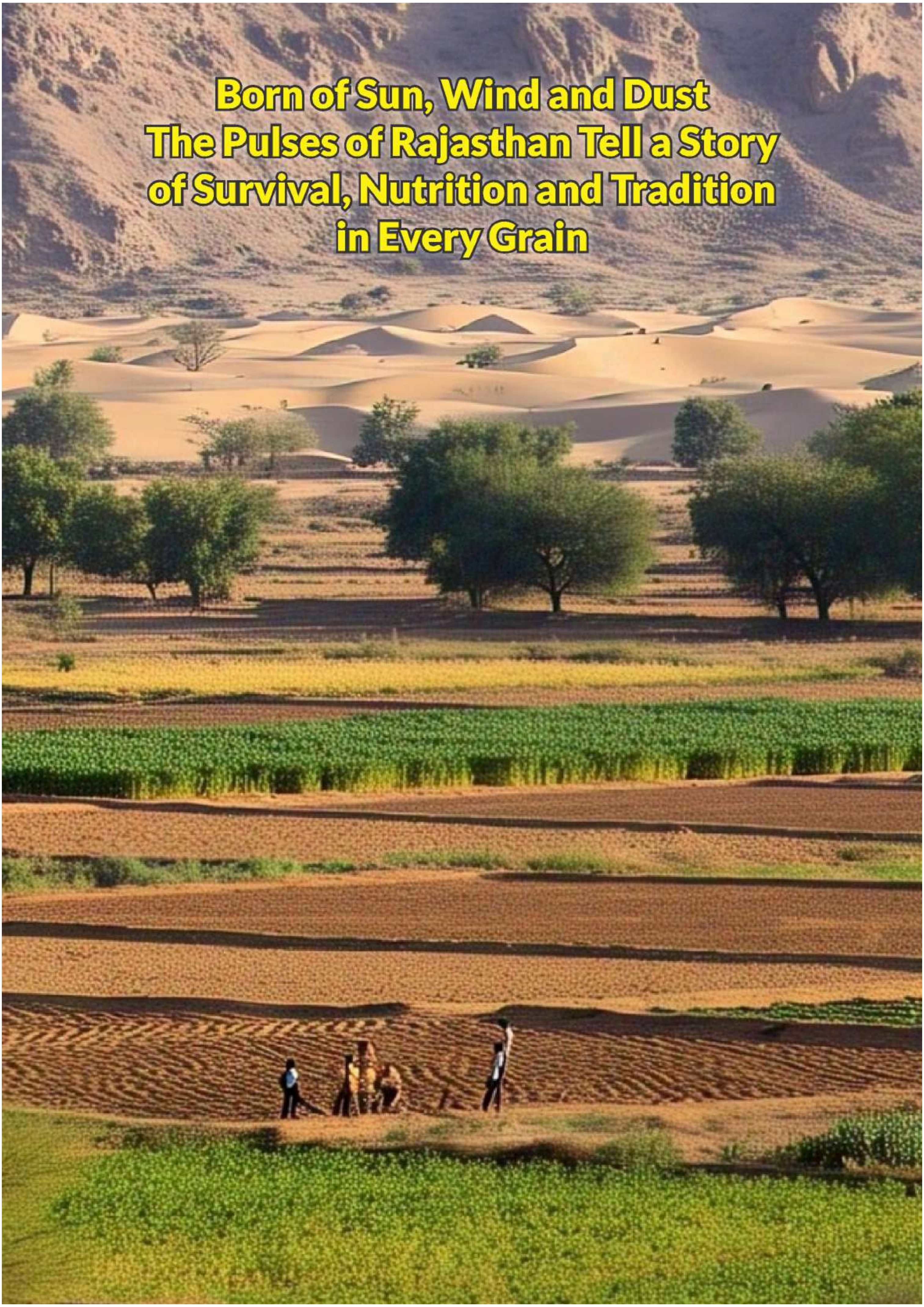
2015 — **RG 578**
Virginia Bunch
Resistant to LLS, dry root rot, rust
Tolerant to *S. litura*, thrips, jassids and leaf miner

2016 — **RG 559-3**
High Yielding Variety
Virginia Bunch
Large seeded; tolerant to *S.litura* and thrips

2023 — **RG 638**
High shelling %, It matures in 122 days, average pod yield 35-40 Q/ha.

2024 — **RG 648**
It exhibited 22.0% and 25.2% superiority in pod (32.69 q/ha) and kernel yield (22.73 q/ha) over best check, respectively.

2024 — **RG 575-1**
It exhibited 11.08% and 12.3% superiority in pod (29.96q/ha) and kernel yield (20.38 q/ha) over best check, respectively.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in Every Grain