

Technology Package
for
RABI CROPS

2025



Directorate of Extension
Sher-e-Kashmir
University of Agricultural Sciences & Technology of Jammu

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FOREWORD

Rabi crops form the backbone of agricultural activity in the Jammu region during the winter season. Crops such as wheat, mustard, chickpea, lentil, oats, and barley play a crucial role in ensuring food and nutritional security, fodder availability, and enhancing the livelihoods of farming communities. However, to unlock their full productivity potential, there is a need to promote scientifically proven, location-specific practices that can help farmers improve yields, resource use efficiency, and resilience to climate variability.



Prof. B.N. Tripathi
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It is, therefore, a matter of great satisfaction that the Directorate of Extension, SKUAST-Jammu, has brought out this comprehensive Technology Package for Rabi Crops of Jammu Region. This document serves as a practical and farmer-friendly guide, offering crop-wise scientific recommendations developed through rigorous research and field validation.

The publication provides detailed guidance on improved varieties, land preparation, sowing techniques, nutrient and water management, weed control, integrated pest and disease management, and post-harvest operations. It also reflects the University's broader commitment to promoting sustainable and climate-smart agriculture in the Union Territory.

I compliment the team of experts who have contributed to the development of this package. I am confident that this publication will serve as a valuable tool for farmers, extension personnel, input dealers, and agri-entrepreneurs to strengthen Rabi cropping systems in the Jammu region and contribute meaningfully to the goals of productivity enhancement and rural prosperity.

Place: Jammu
Date: 13.06.2025


(B.N. Tripathi)

PREFACE

The Rabi season is critical for ensuring annual agricultural output in the Jammu region, with cereals, pulses, oilseeds, and fodder crops forming a vital part of the cropping pattern. Despite the importance of this season, productivity gaps remain due to sub-optimal use of inputs, delayed sowing, lack of varietal awareness, and emerging challenges from climate change and biotic stresses.

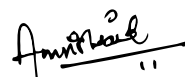


Dr. Amrish Vaid
Director Extension
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In this context, the Technology Package for Rabi Crops of Jammu Region has been prepared to provide region-specific, updated, and easy-to-follow technical recommendations. The package includes comprehensive information on the cultivation practices of major Rabi crops such as wheat, mustard, chickpea, lentil, oats, and more, keeping in view the agro-climatic diversity and socio-economic conditions of farmers in the region.

The recommendations provided here are based on field research conducted at the university's research stations, coordinated trials, and experiences from Krishi Vigyan Kendras (KVKs) and on-farm demonstrations. This package aims to bridge the gap between research and field-level adoption by providing actionable information in a concise format.

I take this opportunity to acknowledge the hard work of the team of scientists, technical staff, and editors who have contributed to the preparation of this package. I hope that this effort will assist farmers and extension workers in optimizing input use, enhancing yields, and ensuring sustainable Rabi agriculture in the Jammu region.


(Amrish Vaid)

CAUTION

Recommendations of varieties and production techniques given in this book holds good only when used under optimum growing conditions in respective agro-climatic situations. The performance of varieties may change in due course of time due several factors (including climatic variation or a-biotic and biotic stress reasons). The chemicals used to control insect-pests, diseases and weeds are poisons for human beings and should adopt eco-friendly methods as far as possible. Farmers are advised to use these poisons carefully to avoid any ill effect on human health and environment. Mishandling/negligence of the user may result in damage/loss/non-reproducibility of results.

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Wheat

Wheat (*Triticum aestivum*) is very important food grain crop of Jammu province of Jammu and Kashmir (J&K) Union Territory (UT). The total area under wheat cultivation is 254.7 thousand hectares, out of which 249 thousand hectares area is being cultivated in Jammu division with considerably high average yield.

Based upon the research work and on-farm testing, production recommendations for obtaining high yields of wheat under different conditions of Jammu region are described as under:

Climatic requirements: Wheat needs cool climate during the early part of its growth. Sowing of wheat offers considerable advantage when mean temperature is 20°C. Sowing at lower day temperature delays germination and reduces the length of growing season. Warm temperature during early season is unfavourable for tillering. Too much of rains during the season causes heavy incidence of rusts. At the time of maturity warm and dry weather is beneficial for uniform ripening of grains. Areas, having winter rains but remain rain-free during April-May offer considerable advantage in Wheat growing.

Soil requirement: Wheat can be grown under varied soil condition. However, cultivation of Wheat on highly deteriorated soil should be avoided. Most suitable soils are those, which have higher water holding capacity and do not suffer from impeded drainage.

Recommended varieties, sowing time and salient features

A] Sub Tropical Zone (Upto 800 m)

1) Irrigated

S.No	Sub Tropical Irrigated condition /Time of sowing and maturity	Name of the variety	Year of release	Av. Yield /q/acre	Salient features
a.	Timely sown/1st to 25 th November Maturity days 150-160	1. JAUW 584	2019	20.8	Moderately resistant to all three rusts with excellent chapatti making quality.

		2. HD 3226	2019	23.0	Resistant to all rusts, Karnal Bunt & loose Protein 12.8 % , good for chapati & bread.
		3. DBW 222 (Karan Narendra)	2019	24.5	Moderately resistant to brown & yellow rust, Tolerant to lodging, resistant to Karnal Bunt
		4. DBW 187 (Karan Vandna)	2019	24.5	Can also be sown earlier in last week of Oct. High iron content, Good for biscuit making.
		5. WB-2	2017	20.6	Quality wheat with high iron (40ppm) and zinc (42 ppm) resistant to yellow brown rust.
		6. RSP 561	2015	16.8	Can also be sown under late conditions. Tolerant to late heat condition. Moderately resistant to yellow & brown rust.
		7. HD 3086	2014	16.4	Resistant to yellow and brown rust. Good for bread and chapati.

		8. DBW 88	2014	21.7	Moderately resistant to yellow & brown rust.
		9. WH 1105	2013	16.0	Moderately resistant to yellow & brown rust.
		10. HD 2967	2009	16.4	Moderately resistant to yellow & brown rust.
b.	Late sown 20th Nov to 25th Dec Maturity 130-140	1. PBW - 752	2018	15.2	Resistant to yellow and brown rust.
		2. DBW-173	2018	15.2	Tolerant to terminal heat and resistant to yellow and brown rust.
		3. DBW-90	2014	13.2	Resistant to yellow and brown rust.
C	Very late 26th Dec-15 Jan Maturity 120-130 days	1. PBW-757	2018		Resistance to yellow and brown rust. It has high zinc content (42.3 ppm)
2.	Rainfed (25 th Oct – 5 th Nov)	1. PBW660	2016	12.0	Resistant to yellow and brown rust good chapatti making quality.
		2. PBW 664	2012	11.2	Highly resistant to yellow rust.
		3. WH 1080	2011	9.6	Moderately resistant to rust with high protein content.
3.	Restricted Irrigation (25 th Oct – 5 th Nov)	1. JAUW-672	2022	17.8	Moderately resistant to all three rusts.

		2. HD 3237	2019	13.2	Resistant to yellow & brown rust.
		3. HI1620	2018	13.6	Resistant to yellow & brown rust.
		4. WH1142	2015	12.8	Moderately resistant to yellow & brown rust, good for bread making.
		5. HD3043	2012	11.6	Resistant to yellow & brown rust.

B. Intermediate (Mid Altitude) 800-1350 m amsl and Temperate above 1500 m amsl.

S.No	Sub Tropical Irrigated condition /Time of sowing and maturity	Name of the variety	Year of release	Av. Yield / q/acre	Salient features
a.	Irrigated/rainfed Timely sown 2nd to 4th week of November	1. HS 562	2016	14.4	Resistant to yellow & brown rust.
		2. HP W349	2013	10.0	Resistant to yellow & brown rust with good chapatti quality.
		3. VL 907	2010	11.2	Resistant to yellow & brown rust with high iron content.

b.	Rainfed, Timely sown Last week of October to end of November	1. VL 832	2004	10.4	Resistant to yellow & brown rust tolerant to Hill bunt & loose smut.
		2. VL 804	2002		
	Late sown rainfed	1. HPW 373	2022-23	10.9	
		2. HS 490	2009	12.4	Resistant to yellow & brown rust, good for biscuit making.
		3. VL 892	2008		High Zinc, copper and Magnesium.
	c	Temperate(High altitude)	VL907, HS507, HPW349, VL804		
Irrigated/rainfed 2nd to 4th week of November		375	2003	10.4	Early maturity with golden grains

Recently released wheat varieties

S.No	Production condition	Name of variety	Year of release	Average yield/q/acre	Sailent features
1	Early sown, Irrigated (Nov 1-10)	DBW 327	2021-22	32.1	Drought and Heat tolerant
2		DBW 332	2021-22	31.6	High Protein Content (12.2 %)
3		DBW303	2022-23	23.5	High yield, resistance
4		PBW872	2022-23	30.4	High Fe(42.3 ppm) and Zn (40.7 ppm) (Bio-fortified)
5		DBW 371	2022-23	30.7	High Protein Content (12.2%) and Fe(44.9 ppm) (Bio-fortified)

6		DBW 372	2022-23	30.4	High Protein Content (12.2%) and Fe(40.8 ppm) (Bio-fortified)
7		DBW 370	2022-23	30.3	High Protein Content (12.2%)
8		WH1270	2020-21	30.6	High yield under early sown and high fertility
9	Timely sown, Restricted Irrigation	JAUW672	2022-23	17.8	Resistant to all rusts
10		DBW296	2021-22	22.7	Climate resilient
11		HUW838	2021-22	20.7	Resistant to wheat blast
12		HD3406	2022-23	22.1	3.26 % superior in yield to recurrent parent HD2967
13		HD3369	2022-23	20.4	High Fe (40.6 ppm) content
14		HD3237		19.5	High degree of resistance against yellow and brown rusts, less reduction in yield under no irrigation, good chapatti quality
15	Late Sown, Irrigated	JKW261	2021-22	20.9	Drought and Heat tolerant
16		PBW752	2018-19	19.8	High level of resistance against yellow and brown rust
17	Very late Sown, Irrigated	PBW757	2018-19		High degree of resistance against yellow and brown rust, good chapatti quality
18		HD3298		15.7	High Protein (12.1%) Content
Intermediate and Temperate					
	Timely sown, RF	VL2041	2022-23	11.9	Soft grain (GHI 22.6), Biscuit spread factor (11.7)

Days to maturity and grain yield are reflected under standard package of practice and may vary depending upon time of sowing and climatic conditions prevailing during the season.

Prominent Cropping Systems

A) SUB-TROPICAL

1) Irrigated

- 1.1 Rice (PC-19)-Wheat -Moong
- 1.2 Rice (PC-19)-Wheat (normal sown)- Summer fodder
- 1.3 Rice-Wheat- Green Manure
- 1.4 Rice (IET 1410)- Toria/Potato-Wheat

2) Rainfed

- 2.1 Maize-Wheat
- 2.2 Bajra-Wheat
- 2.3 Pulses-Wheat
- 2.4 Oilseeds (Sesamum) + Mash-Wheat
- 2.5 Green Manuring-Wheat (Where organic carbon is less than 0.5%)

B) INTERMEDIATE

- 1.1. Maize-Wheat
- 1.2. Pulse-Wheat

C) TEMPERATE

- 1.1 Fodder-Wheat
- 1.2 Millet-Wheat under drought prone conditions

Agronomic Practices

Field Preparation:

a) Conventional Tillage: A deep well pulverized field containing enough moisture is very essential for growing wheat crop. Field should be prepared by



single operation of soil turning plough and two harrowing. Planking should be done after each tillage operation to secure fine tilth and to conserve moisture in the soil. Tillage operation under heavy soil conditions should be done at lower plastic limit and under sandy soil at higher plastic limit to prevent clod formation and secure fine tilth. Mud ball made of ploughed soil when crumbles upon being thrown for a distance, denotes right soil consistency for starting field preparation. For the efficient management of stubbles of previous rice crop, apply additional 8 kg N/acre or 2t/acre FYM at the time of first ploughing for sowing of wheat in rice-wheat cropping system.

Use of disc harrow or 3 to 5 tyne harrow in combination with the furrow turning plough saves 30 to 40% time in seed bed preparation as compared to the use of conventional desi plough especially when bullock power is employed. Under rainfed conditions, wheat is usually grown after maize crop and therefore minimum time should be spend on field preparation.

When tractor is the source of power, preparations should be done with cultivator (tiller) thrice or one disc harrowing and two operations of tiller to get a fine seed bed. Planking should follow each such operation. However, mouldboard plough may be used once in three years immediately after the harvest of previous crop to expose insect pests and weed seeds to hot sun rays. This will reduce burden of plant protection.

b) Zero/ Minimum tillage: Wheat can be also grown without any preparatory tillage, if there is no serious problem of weeds to interfere in sowing. In weed infested fields, spray 1-2% Glyphosate before sowing after the harvest of previous crop in a system. The sowing shall be done through the following machines. The optimum depth of seeding should be 3.5-5 cm.

- i) Tractor drawn Zero-till drill or strip-till drill
- ii) Happy Seeder machine- where the paddy fields were harvested with combine

Note: It is advisable that after 3 years of continuous sowing of wheat under zero-tillage, the field should be ploughed to solve the problem of perennial weeds or rodents, if any.

Seed rate: A seed rate of 40 kg per acre of well cleaned and graded seed for normal sowing and 50 kg/acre for December sowing should be used. Farmers should invariably use certified seed and if every year they cannot do so, they should rogue out off type plants & use seed from such plots. For very late sowing conditions (January), the seed rate should be enhanced to 60kg/acre. Use seed-cum-fertilizer drill and if not available adopt pora or kera method of sowing to ensure uniform germination.



Methods of sowing: For ensuring proper germination of seed, wheat must be sown at proper and optimum VATAR (moisture) conditions. Sow wheat by kera and place the fertilizers with pora in one operation, as kera sowing gives good results in combination with placement of fertilizers, but the best results can be achieved when seed-cum-fertilizer drill is used. A drill places seed uniformly at the desired depth in soil and ensures better germination besides it places the fertilizer in the soil at proper depth. It also cuts down the time required for sowing. The optimum sowing depth recommended is 4-5 cm deep and care should be taken not to dump too much soil on the furrow where seed has been sown.

A spacing of 15 to 20 cm between rows should be maintained. However, under dry land conditions sowing may be done in lines 22.5cm apart. Sowing under rainfed conditions should preferably be done in the morning or evening and also field preparation should also be done early in the morning or in the evening. Under very late sown conditions, row-to-row spacing of 15 cm should be maintained and for hastening the emergence, sowing of soaked seed is beneficial. Soak the seed in water for 4-6 hours and spread it in a thin layer and the sowing shall be undertaken.

c) Bed planter Method: Sowing of wheat on raised beds is possible by using bed planter on 37.5cm wide bed and 30cm wide furrow between two beds. This method gives comparable or 2-3% more yield. A seed rate of 32 kg/acre gives similar yield as with 40 kg/acre under conventional (flat) method. The B: C ratio worked was reported to be 2.30 with energy use efficiency as 11.13%.

Fertilizer application: Dosage of fertilizer can either be decided on soil test or field experiment basis. Wherever farm manures or compost are available, should be applied in the *kharif* season. Based upon crop responses, fertilizer use should be made as given below:

Situation	Nutrients (kg/acre)			Fertilizers(kg/acre)			
	N	P ₂ O ₅	K ₂ O	Urea	DAP	MOP	ZnSO ₄ *
Irrigated							
a) Normal sown	40	20	10	70	44	17	8
b) Very late sown	32	16	10	56	35	17	-
c) Restricted Irrigation	37.5	15	10	68.8	32.8	16.8	-
Un-irrigated	24	12	8	42	26	14	4

*Once in three years apply 8kg Zinc sulphate per acre either in soil before sowing or 2-3 foliar sprays of 0.5% ZnSO₄. Prepare the solution by dissolving 1kg ZnSO₄ and ½ kg unslaked lime in 200 L of water for spray in one acre area.



Manganese Deficiency: The symptoms of manganese deficiency appear on the middle leaves as intervenial chlorosis with light greyish yellow to pinkish brown or buff coloured specks of variable size confined largely to 2/3 lower portion of leaf. Later, the specks coalesce forming a streak or band in between the veins which remain green. In acute deficiency, whole of the plant may become dry. At earing stage, the symptoms become prominent on flag leaf.

Sulphur Deficiency: In sandy soils wheat crops suffers from sulphur deficiency. The deficiency becomes more when the winter rains continue for a long period of time. Where phosphorus was not applied as SSP, apply 88kg of gypsum/acre before sowing to meet the sulphur requirement of the crop. The symptoms of sulphur deficiency first appear on the younger leaf with fading of the normal green colour. This is followed in the veins. The topmost leaves become light yellow except for the tip, while the lower leaves retain green colour for a long period. These symptoms should not be confused with the deficiency of nitrogen where the yellowing starts with the lower leaves.

Note: Light textured soil e.g. sandy to loamy sand usually have low water retention capacity and in such soils, ploughing and planking should be done immediately after the *kharif* (main) crop. For best result, it is advised to plough the field in the evening and planking it in the next morning.

Drill entire quantity of DAP+MOP and 50% urea as basal dose at sowing time. Whole quantity of zinc sulphate be mixed with 6-8 kg of dry pulverized soil/acre and applied in the field before sowing but do not mix it with DAP. It can be mixed with nitrogenous or potassic fertilizers but not with phosphatic fertilizers. Remaining half quantity of urea should be applied in the standing crop in two equal doses. First top dressing of urea should be done when first irrigation at crown root initiation stage is given which may coincide with 25 to 30 days after sowing. This should be followed by intercultural operation with medium cultivator or bar harrow. Remaining quantity of urea should be applied just before boot stage (ear initiation).

Integrated nutrient management should be followed for sustainable yield of wheat. In rice-wheat cropping sequence, 50% of NPK through inorganic & 50% NPK through organic in rice followed by full NPK to wheat has given promising results both in terms of yield & soil health.

In unirrigated areas, 2/3rd of urea should be applied as basal dose along with the entire quantity of DAP+MOP and zinc sulphate in the manner as described above. Remaining 1/3rd nitrogen through urea should be applied in the standing crop when there is likelihood of first rain. It should not be applied if boot stage has passed.



The 3% urea spray may be used as a supplementary dose at late tillering and late jointing stage, if deficiency of nitrogen is felt. Mix 9kg of urea in 300 L of water, which is sufficient for 1 acre cropped area, when crop is sprayed with high volume sprayer. Low volume sprayer can also be used without changing the quantity of urea. Urea spraying should preferably be done in the morning or in the evening hours only under un-irrigated conditions.

Combined foliar spray of 0.5% N (through urea) and 0.5% K (through KCl) with recommended dose of fertilizer is recommended under rainfed conditions of Jammu region.

Time and method of fertilizer application

- i) If green manuring has been done then reduce the dose of nitrogen to one half. Apply phosphorus recommended for wheat to the green manuring crop.
- ii) Apply less nitrogen (25%) dose to wheat sown after leguminous crops.
- iii) Apply 25% less nitrogen when 6 tonnes of poultry manure is applied in rice crop.
- iv) In case of Potato-Wheat cropping sequence where already FYM was applied @ 20 tonnes/ha, skip the dose of phosphorus.
- v) If recommended dose of Zinc was applied in *kharif* crops then skip the application of Zinc in wheat crop.
- vi) Manganese deficiency generally appears in light soils under intensive cropping especially in rice-wheat rotation. If deficiency of manganese is noticed, then apply 0.5% manganese sulphate solution (1kg manganese sulphate in 200 litres of water) 2-4 days before first irrigation and three sprays afterwards at weekly intervals on sunny days. Manganese application should be done only after the soil testing of the field.

Crop Residue Management: The incorporation of chopped rice residue in wheat and wheat residues in rice (5t/ha) or fly ash (2t/ha) under both adequate and limited moisture condition coupled with inoculation of *Trichoderma viridae* (culture separated with FYM applied @ 10 g/kg of FYM) and 20kg N/ha increased the crop production.

Irrigation: If there is inadequate moisture in the upper 10 cm layer, pre-sowing irrigation should be given otherwise first irrigation should be applied at the crown root initiation stage which generally comes about three weeks after sowing in dwarf genotypes. This interval may be somewhat longer in case of late sown wheat. In paddy growing areas under heavy soil conditions, first irrigation should be applied after one month of sowing. Subsequent irrigations should be

applied as and when needed. The irrigation interval may vary from 20 to 30 days depending upon the soil type and weather conditions.

There should be sufficient soil moisture at crown root initiation, tillering, jointing, flowering, milk and dough stages and irrigations are to be applied accordingly. However, the most critical stages of moisture stress for wheat crop and crown root initiation and milk stages.

Two irrigations should be applied especially in areas where water table is within 1.2 to 1.5 m during wheat growing season. First irrigation should be given after one month of sowing and second at milk stage. No irrigation should be applied where water table is less than 90 cm deep.

Intercultural operational & weed control: First hoeing should be given about a month after sowing to keep down weeds. Hand hoe may be used for this operation. In early stages of growth, use of bar harrow after winter rains in unirrigated fields and after the first irrigation in other fields is also beneficial. Chemical weed control is not a substitute for hand weeding or intercultural operations.

Weed management

- a) Broad leaf weeds associated with wheat crop can be managed with the use of 0.3 kg a.i./ acre amine salt or 0.2 kg a.i./acre of ethyl ester of 2, 4- D in 200-240 liters of water/acre when high volume sprayer is used. In timely sown wheat apply 2, 4-D herbicide 28-35 days after sowing which may coincide with 4 to 6 leaf stage of the crop. Do not spray 2, 4-D when wheat has been grown mixed with any legume, dicot crop or mustard.
- b) Monocot weeds associated with wheat crop can be controlled by spraying isoproturon @ 0.3 kg a.i./ha 30-35 days after sowing of wheat. For the control of both monocot and dicot type of weeds in wheat, isoproturon @ 0.3kg a.i +2, 4-D of ethyl ester @200ml per acre may be sprayed 30-35 days after sowing.

Control of *Phalaris minor* (Sitti): In case *phalaris minor* is not controlled by isoproturon, metribuzin @ 114 g /acre dissolved in 200-300 L of water can be used with high volume spray pump 30-35 days after sowing, when *phalaris minor* is at 2-3 leaf stage and wheat is at 3-4 leaf stage. It is effective against both grassy and broad leaved weeds. The herbicides mainly clodinafop (15 WP) @ 160g/acre and fenoxaprop-p-ethyl (9.3EC) @ 4.3 kg/acre at 30-35 days after sowing is effective in controlling the *sitti*.

Where “*sitti*” is a serious problem, adopt crop rotation by sowing berseem instead of wheat, as berseem helps in its control by repeated cuttings before flowering. However, other crops like linseed, mustard can also be sown since

sitti plants are easily detectable in these crops. Therefore, *sitti* plants can be removed by hand weeding before flowering takes place.

Crop association with wheat

The crops, which are incompatible with wheat, should never be mixed. For example, wheat should never be sown mixed with mustard, gram, etc., because wheat has a shading effect on gram and mustard. At the same time, the fertilizer requirements of wheat, gram and mustard are different. Moreover, when wheat is sown mixed, chemical weed control and aphid control of mustard cannot be undertaken.

However these crops may be sown as inter-crops in strips in the ratio of 8:1 especially under rainfed conditions i.e. sow 8 rows of wheat alternate with 1 row mustard.

Harvesting and Threshing: To avoid shattering of grains, wheat crop should be harvested and threshed before it is dead ripe. Combines can also be used for harvesting and threshing operations. If the crop is harvested with manual labour, power threshers and drummy thresher can be economically used for threshing.

Tips for maximizing wheat yield

1. Prepare crumb seed bed containing plenty of moisture
2. Always select the right variety recommended for the area and ensure timely sowing.
3. Irrigate the crop at crown root initiation stage positively.
4. Take appropriate plant protection measures both for seed and soil wherever necessary.
5. Adopt recommended seed rate and spacing.
6. Sow the seeds in lines at proper depth and ensure placement of fertilizers and top dressing of fertilizers as recommended for your area.
7. Apply recommended dose of fertilizers.
8. Adopt proper weed management practices with greater emphasis on integrated weed management.
9. Harvest and thresh the crop in time to avoid losses due to grain shattering and bad weather.

10. For taking third crop of summer Moong/ Fodder in between the wheat and rice, wheat sowing should be done in first week of Nov. to enable sowing of summer crop in 3rd week of April in sub-tropical plain irrigated areas.
11. After harvesting wheat bundies should be stacked with heads upward.
12. Seed treatment may be done in the order of pesticides, fungicides and bacterial diseases.
13. Use summer ploughing to reduce the menace of weeds, soil born insect pests and diseases.
14. Incorporate crop residues in the soil after harvest of crop to maintain organic carbon level of soil at reasonable standard, which is, necessary to sustain higher yields.

Plant Protection

I. Insect-pest and their Management

S.no	Pest and symptoms	Management practices
1.	<p>Termites (<i>Microtermes obesi</i>, <i>Odontotermes obesus</i>): They damage the crop soon after sowing and near maturity. The damaged plants dry up completely, can be easily pulled out and fall on ground due to wind.</p>	<p>a) Seed treatment: Use chlorpyrifos 20EC @ 2ml /litre of water or fipronil 5SC @ 1.5ml/litre of water, imidacloprid 48FS @ 5-10g/kg of seeds for seed treatment. Mix the desired insecticide in 5L of water. Sprinkle this solution over a heap of one quintal of wheat seed and mix thoroughly. Keep the treated seed in thin layer over night and sow it next morning.</p> <p>b) Soil treatment: Treat soil with cartap hydrochloride 4G @ 8 kg/acre after the last ploughing and before planking in areas where termite attack is recurrent and seed treatment could not be done. For termites control in standing crop, dilute 4L of chlorpyrifos 20EC in 5L of water and mix in 50 kg of sand thoroughly. Broadcast this treated soil in the infested areas.</p> <p>c) Never use raw FYM</p> <p>d) Destroy termitaria in and around field.</p>

2.	<p>Field rats (<i>Tatera indica</i>, <i>Bandicota bangalensis</i> and <i>Millardia meltada</i>) cause heavy losses to the crop.</p>	<p>Control of rats need to be adopted on community basis: Day 0: Survey and demarcate the area Day 1: Lag day Day 2: Pre-baiting. (Smear 1kg wheat, gram, maize or bajra grains or flour with vegetable oil & small quantity of Gur.) Day 3: Repeat pre-baiting. Day 4: Give poison baiting. (Smear 1kg wheat, gram maize, or bajra grains or flour with vegetables oil and gur an mix with it 25 g Zinc phosphide (1:40). If flour is used, prepare small pellets of gram size. Put 5-6 pellets or one tablespoonful of grains per burrow. Day 5: Close burrow opening. Day6: Harbourage, removal & sanitation. Rat control campaign must be organized at all places on same day as per schedule for its success. Rodent management practices: a) Bund trimming to minimize rodent harbourage. b) Demolish the existing rodent burrows. c) Use indigenous traps. Economic threshold level is 6 live burrows/acre</p>
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Sporadic Insect Pests

S.no	Pest and symptoms	Management practices
3.	<p>Army worm (<i>Mythimna separata</i>) Greenish or dusty brown with pale brown striped caterpillars feed on the leaves at night and rest during day. In severe infestation feeding may be noticed during the day time also.</p>	<ol style="list-style-type: none"> 1. Collect the caterpillars and kill them. 2. Economic threshold for army worm is 15 larvae/meter row length of the crop. 3. Spray chlorpyriphos 20 EC @ 480 ml/acre or spraying malathion 50 EC @ 2 ml/litre of water or 480 ml/acre on appearance of pest. 4. Conserve bio-control agents like <i>cotesia ruficras</i>, <i>Trichogramma</i> sp. and spiders. 5. If necessary spray the crop with methyl demeton 25EC @ 1ml/litre of water or dimethoate 30 EC @ 2ml/litre of water in 240 litre of water/acre or imidacloprid 17.8 SL @ 0.3 ml/litre of water.

Minor Insect Pests

S.no	Pest and symptoms	Management practices
4.	Sucking insects like aphids, jassids, brown mite etc., which suck sap from leaves and earheads.	High volume spray for aphids should be preferred.
5.	Bird control	<p>Mechanical control</p> <ol style="list-style-type: none"> 1. Shot the bird with gun. 2. Scare away birds by hanging dead birds in the field or by drumming etc. 3. Destroy eggs & nests during June-August of house crows, April-May & September-October of house sparrows, baya and red finches. March-June for parakeets and blue rock pigeon. <p>Use bird scarers such as sound devices and sticky materials on their perching places and/ or reflecting ribbons to keep away the birds.</p>

II. Disease and their Management

S.no	Disease and symptoms	Management practices
1	Yellow Rust or Stripe Rust (<i>Puccinia striiformis</i>): Small yellow, elliptical pustules on leaves which run in rows forming stripes later turn black. Sometimes pustules appear on leaf sheaths and ear heads also.	<ol style="list-style-type: none"> 1. Use resistant varieties and adopt timely sowing. 2. Spray the crop with propiconazole or tebuconazole @ 0.1%. First spray is to be given at the initiation of disease and repeat spraying after 10-14 days interval, if needed. 3. Field sanitation and use of balanced dose of nitrogenous fertilizer can reduce the rust incidence.



2	Brown Rust or Leaf Rust (<i>Puccinia recondita</i>): Brown, round orange pustules irregularly arranged or in clusters on leaves, less common on leaf sheath and stalk.	Same as in case of yellow rust or stripe rust.
3	Loose Smut (<i>Ustilago segetum</i>): The ears turn in to black loose powdery mass consisting of spores.	<ol style="list-style-type: none"> 1. Use resistant varieties. 2. Rogue out the infected ear heads at yellowing of flag leaves. 3. Treat the seed with carboxin @ 2g/kg of seed or tebuconazole 2DS @1.25g/kg of seed. 4. During the sunny days of May and June in subtropical areas, loose smut infection in wheat seeds can also be managed by solar heat treatment of seeds as an alternative to chemical seed treatment. Soak wheat seed in water at room temperature for 4 hours (8 a.m. to 12'O clock noon). Drain water and dry seeds in open sun by spreading it on tarpaulin or cemented or mud plastered ground from 12'O clock till evening. Three to four turnings of seeds are required to ensure uniform drying. Store the seeds till next sowing.
4	Flag Smut (<i>Urocystis agropyrii</i>): Long narrow stripes leading to grey or black stripes parallel to veins are formed on leaves. The stripes eventually rupture and expose black sooty masses of spores.	<ol style="list-style-type: none"> 1. Same as for loose smut or treat the seed with tebuconazole 2DS @1.25g/kg of seed. Late and deep sowing of wheat should be avoided. 2. Rogue out the affected plants and destroy them by burning.

5	Karnal Bunt (<i>Tilletia indica</i>): Disease grains partly converted into black sooty powder, which smells like rotten fish. Only few ears and few grains in ears are affected.	<ol style="list-style-type: none"> 1. Seed treatment as given in loose smut. 2. Use resistant varieties and disease free seeds. 3. Spray propiconazole @ 0.1% at booting to flowering stage. 4. Avoid excessive irrigation particularly during flowering stage.
6	Powdery Mildew (<i>Erysiphe graminis</i>): White to dark coloured powdery mass appears on all aerial parts of plant.	Spray the crop with wettable sulphur @ 0.25% or calaxin 0.1% at the time of disease initiation, repeated sprays may be given at 10-14 days interval depending upon the disease severity.
7	Leaf Blight (<i>Alternaria/Bipolaris spp.</i>): Leaves show reddish brown spots with yellow marginal zone, later spots coalesce giving the leaf a blighted appearance.	On the appearance of disease, spray the crop with propiconazole/tebuconazole @ 0.1% .

Barley

Barley (*Hordeum vulgare*) is the most efficient crop under rainfed conditions and is best suited for light soils. Under irrigated conditions it is economical under different soil management conditions. It is also best suited for salt affected soils.

Climatic requirements: Barley requires cool climate during early growth and dry weather at maturity. It is drought resistant crop and is suitable for dry areas with scanty rainfall.

Soil: Barley grows well in well-drained loamy soils.

Varieties: Varieties recommended for plains and hilly tracts of Jammu division are:

1. **Ratna:** The variety is recommended for rainfed areas. It matures within 125-130 days and gives a fairly good yield even under unfavourable environment conditions. It yields about 60q/acre of green fodder after 65 days of sowing and regeneration crop yielding 8q/acre of seed.

2. **Jyoti:** It is suitable for growing in irrigated areas and matures in 120-125 days. It has yield potential of about 14-16q/acre.

3. **Sonu:** This variety is released for sowing in low and mid hill areas (upto 1500 m amsl) under timely or late sown, unirrigated or restricted irrigated conditions. It is about a week early in maturity and possesses bold, light yellow attractive grains. It is moderately resistant to yellow rust and Helminthosporium leaf stripe, highly resistant to shattering and lodging.

4. **RD-2849:** This variety is released for irrigated timely sown conditions. The potential grain yield of the variety is 19.5q/acre. It has resistance to stripe rust.

Agronomic Practices

Land Preparation: A smooth seedbed is required for a good crop of barley. The field should be tilled with soil turning plough (Tawi plough), followed by 2 to 3 operations with disc harrow/ soil stirring plough or *desi* plough. Each operation should be followed by planking.

Seed Rate: 40 kg of seed is sufficient for one acre.

Time of sowing: Appropriate time of sowing varies from mid October to end of November. However, sowing can be extended up to mid December.



apply fertilizers with *pora*. Where moisture is insufficient, apply fertilizers through *pora with* last ploughing and plank the field. Sow the seed by *kerā*. Barley rows should be spaced 20 to 22.5 cm apart and seed should be sown not more than 5 to 6 cm deep in the soil.

Fertilizer application: For efficient use of fertilizers the soil should be tested well in advance before sowing from the nearest soil testing laboratory and fertilizers should be applied on soil test basis. In absence of such results, the following generalized recommendations may be followed:

Nutrient (kg/acre)			Fertilizers (kg/acre)		
N	P ₂ O ₅	K ₂ O	Urea	DAP	MOP
16	8	8	28	18	14

Apply ½ of N along with whole of P₂O₅ & K₂O as basal and remaining dose of N may be top dressed at tillering and earing stages or as and when there are rains.

Mixed cropping in barley: Barley can be grown mixed with gram in the seed mixture ratio of 1:1 and with field peas in the ratio of 2:1.

Weed Control: One hoeing and weeding preferably with improved wheat hand hoe should be done after first irrigation. For the chemical weed control of broad leaf weeds spray 2,4 D ethyl ester (36%) @ 260g or ml of commercial product in 200ml of water/acre when the crop is 40-45 days old (Maximum tillering stage) in case of normal sown crop but is not yet at the jointing stage. For control of wild oats, *Phalaris minor*, same weed control treatment as in 'Wheat'.

Harvesting and Threshing: To avoid grain shattering, barley should be harvested and threshed as soon as it is fully ripe.

Tips for maximization of yield

1. Prepare fine smooth seed bed containing adequate moisture.
2. Sow recommended variety at optimum time and apply recommended dose of fertilizers.
3. Adopt pre and post sowing plant protection measures.
4. Harvest and thresh the crop at proper time to avoid losses due to shattering of grains.
5. Barley is often susceptible to nematodes; use resistant variety wherever nematode incidence is detected.



6. Avoid copious use of nitrogen and irrigation as the crop is highly susceptible to lodging, which reduces quantity and quality of grains.

Plant Protection

I. **Insect Pest and their Management:** same as for wheat crop.

II. Diseases and their Management

S.no	Disease Symptoms	Management
1.	Covered Smut (<i>Ustilago hordei</i>): The entire ear except the awns, turn into compact mass of spores.	Seed treatment same as in loose smut of wheat.
2.	Loose Smut (<i>Ustilago nuda</i>): The smut sori are enclosed in a fragile membrane which soon ruptures releasing the dark dust of spore mass which is disseminated by wind leaving the naked rachis.	Seed treatment same as in loose smut of wheat.
3.	Leaf Stripe (<i>Drechslera graminium</i>): Yellow to brown stripes on leaves, plants become stunted with sheathed leaves and wither away due to systemic infection.	<ol style="list-style-type: none"> 1. Field sanitation. 2. Seed treatment with tebuconazole 2DS @ 1.25g/kg of seed. 3. Use resistant varieties.
4.	Leaf blight (<i>Drechslera</i> spp.): Dark brown necrotic spot develop into long stripes on leaves which dry up prematurely.	Same as recommended in blight of wheat.

PULSES

Pulses are important not only because they form a daily diet of the common man but mainly because they are potential source of proteins in vegetarian diets. Further these can be cultivated on less fertile soils with low initial investment and in turn can improve soil fertility by providing it with rich supplies of nitrogen in which most of our soils are deficient. Pulse crop can increase the cropping intensity by incorporating short duration varieties in the cropping sequences. Despite the fact that pulses are cultivated over a reasonable area, pulse production is insufficient because of inadequate understanding of these crops. Hence there is every need to raise the production of pulses by adopting suitable package of practices which are detailed as under;

Chick Pea

Chickpea (*Cicer arietinum*) is one of the most important pulse crop grown during *rabi* season. Production can be increased by adopting improved cultivation practices. It can be grown up to 2000ft. altitude.

Soil: Chickpea grows best on well drained light to medium textured soils. Saline, alkaline & waterlogged soils are not good for its cultivation.

Climatic requirements; It is primarily a crop of low rainfall areas but gives good returns under irrigated conditions as well. Extreme climates like severe cold and frost are injurious to its growth. Excess rainfall, heavy soil moisture either at time of sowing or at flowering stage are deleterious to crop growth. Early onset of summer and increased day length reduce the yield by hastening maturity.

Varieties

1. **C-235:** It is tolerant to stem rot and blight diseases. The seeds are medium in size and yellowish brown in colour. The variety matures in about 145 to 150 days and yields 9.20q/acre.
2. **K-468:** It is an early maturing variety, mature in about 140 to 150 days and produces an average yield of 11.20q/acre. The seeds are small and yellowish brown in colour.
3. **Gaurav:** It is tolerant to stem rot and blight diseases. The variety matures in about 145 to 150 days and yields 9.20q/acre. The seeds are bold and yellowish brown in colour.



4. **PBG-1:** It is tolerant to ascochyta blight, matures in 160 days with yield potential of 6.4-7.20 q/acre.
5. **SCS-3:** It is early maturing variety, resistant to wilt and tolerant to terminal moisture stress. It is medium seeded brown coloured seeds, semi dwarf, moderately resistant to pod borer having yield potential of 7.0q/acre.
6. **GNG-469:** It is bold seeded variety having yield potential of 8.0-8.8q/acre. It requires 145-150 days for maturity. It is resistant to ascochyta blight, tolerant to wilt and root rot.
7. **RSG 963:** It is moderately resistant to wilt, dry root rot, B.G.M. & collar rot, pod borer & nematodes.
8. **GNG 1969:** This variety is suitable for normal sown in irrigated condition. It possesses creamy beige seed colour with 26.2g/100 seeds having yield potential of 8.8q/acre and requires 146 days for maturity.
9. **GLK 28127:** The seeds of the variety are large (36.0 g/100 seeds), light yellow or creamy colour with irregular owl head. Its seed yield potential is 8.40q/acre and matures in 149 days.
10. **GNG 1581:** It is resistant to water logging condition and has yield potential of 9.60q/acre. Matures in 127-177 days.
11. **GPF 2:** Plants grow erect with thick stem resistant in lodging. It requires 134-163 days for maturity and has yield potential of 8.8q/acre.
12. **CSJ 515:** It has small brown colour seed (17.0 g/100 seed), moderately resistance to dry root rot and tolerant to ascochyta blight and BGM. It matures in 135 days and has yield potential of 9.60q/acre.
13. **GLK 28127:** It is recommended for irrigated belts. The seeds are large (36.0 g/100 seeds), light yellow or creamy colour with irregular owl head. The crop matures in 149 days and yield potential of 8.40q/acre.
14. **DCP 92-3:** It is tolerant to lodging, wilt resistant, yellowish small seeds with yield potential of 9.40q/acre.

Agronomic Practices

Field preparation: Chickpea does not require fine tilth but the soil should be well opened, Loose and well aerated soil has remarkable effect on the control of wilt and increases the grain yield considerably. First ploughing with soil turning plough followed by 2 to 3 ploughings with disc harrow or soil stirring plough will give the desired tilth to soil. Each operation should be followed by planking.



Seed rate: For bold seeded varieties 30-32 kg/ acre and for small seeded varieties use 24-26 kg/acre.

Inoculation of seed: The seed should be inoculated with '*Rhizobium culture*' before sowing.

Fertilizer requirement: Get the soil tested and in absence of soil test follow the following fertilizer schedules:

Nutrient (kg/acre)			Fertilizers (kg/acre)		
N	P ₂ O ₅	K ₂ O	Urea	DAP	MOP
6	16	-	-	35	-

Apply whole quantity of DAP before sowing.

Conservation of moisture under rainfed condition:

- i) Level the field before the arrival of monsoon.
- ii) If possible, divide the whole field into small plots with strong bunds. Bunds made will not allow the water as runoff.
- iii) Don't allow weed to grow in the plots as they will compete with the main crop for water and nutrients.
- iv) Open up the land with the first showers. Plough deep when subsequent shower of rainwater is readily absorbed in the cultivated soil and the loss through evaporation and drainage is also minimized. Towards the end of the rainy season, ploughing should invariably be followed by planking.
- v) Plough the field only once. If the soil appears deficient in moisture, run a roller about a week before sowing.

Sowing time: Mid-October is the optimum sowing time. However, sowing can be done up to end of October if there is no option.

Method of sowing: Chickpea should be sown by *pora/ker*a in rows 30 cm apart. The seed should be placed 5 to 7 cm deep. Avoid shallow sowing as it encourages wilt attack upon irrigation.

Weed management: Weed control up to 4 to 5 weeks after sowing is very essential otherwise there will be reduction in yield. One or two hand hoeing preferable with wheel hand hoe at 30 and 60 DAS. Pre-emergence application of pendimethalin @ 400 g a.i./acre dissolved in 200 litres of water/ha was found effective against mixed flora of weeds. Pendimethalin 30 EC formulation +



Imazethapyr 2 % (ready mix combination) @ 400 g/acre as pre emergence dissolved in 200 litres of water/acre + one hoeing at 30-35 DAS is effective to control *Chenopodium album*, *Melilotus indica*, *Fumaria parviflora*, *Cyperus rotundus*, *Cynodon dactylon*, *Phalaris minor* and *Anagalis arvensis*.

Irrigation: If water is available, irrigation at branching and pod formation stage may be given when there is no winter rain.

Nipping: For chickpea nipping is very important farm operation. It will keep down excessive vegetative growth which otherwise reduces number of pods. Nipping regularizes the vegetative growth and ensures greater number of pods per plant. It should be done before branching.

Crop association in Chickpea: Chickpea can be sown mixed with barley in seed mixture ratio of 1:1 or inter-cropping with mustard with 4 rows of gram alternated with 1 row of mustard.

Harvesting: The crop should be harvested when the pods are mature and plants start drying up. None of legume crops should be uprooted. It should be harvested 4-5 cm above ground by cutting with sickles.

Tips for maximizing chickpea yield:

1. Grow recommended variety to ensure disease free condition.
2. Inoculate the seed with *Rhizobium* culture before sowing.
3. Place fertilizer by *Pora* and sow seed behind plough by *kera*.
4. Ensure effective management of pod borer.
5. Ensure freedom from weeds through integrated weed management practices.

Plant Protection

I. Insect Pests and their Management

S.no	Insect-pest management	Control measures
1.	Pod borer (<i>Helicoverpa armigera</i>): It is a polyphagous pest. The caterpillars damage the crop by feeding on leaves, flowers, buds and pods. It bore into developing seed.	a) Cultural control <ol style="list-style-type: none"> 1. Use resistant/ tolerant varieties. 2. Ploughing after harvesting of crop for destruction of pupae.

		<p>3. Intercropping with non-preferred host plants like mustard, linseed or coriander (6:2).</p> <p>b) Mechanical control: Collect grown up larvae of <i>Helicoverpa</i> and destroy them.</p> <p>c) Biological control</p> <ol style="list-style-type: none"> 1. Conserve predatory wasp parasites and spiders. 2. Install 'T' shaped bird perches @ 8-10/acre to encourage predatory birds for picking larvae of <i>Helicoverpa</i> larvae. <p>d) Chemical control: Spray the crop with novaluron 10EC @ 1ml/L or profenfos 50 EC @ 2ml/litre or NSKE (Neem extract) 5% @ 1g/litre water at pod initiation stage. Repeat the spray after 15 days of spraying if need arises.</p> <p>e) Pest monitoring: Economic threshold level is 1 larva/5 plants or 5-6 moths/trap/day for <i>Helicoverpa</i>. Use pheromone traps for pest monitoring and when it reaches ETL, install pheromone traps @8/acre for mass trapping of the male moths.</p>
<p>2.</p>	<p>Cut worm (<i>Agrotis</i> spp): It is also a polyphagous pest and nocturnal in habit. The larvae cut the germinating plants at ground level or branches of grown up plants.</p>	<ol style="list-style-type: none"> 1. Install light traps @ 1/acre for mass collection and destruction. 2. Install pheromone traps @ 15/acre to attract and kill male moths. 3. Mix 800 ml of chlorpyrifos 20 EC in 10 kg of sand/acre in rows of the plants at sowing time. Where soil application could not be given spray the crop with chlorpyrifos 20 EC @ 480 ml/acre. Spraying should be direct on the soil surface.

II. Diseases and their Management

S.no	Disease and symptoms	Management
1.	Blight (<i>Ascochyta rabiei</i>): Dark brown spots with dot like bodies are produced on the stem, branches, leaf-lets and pods. The disease spreads rapidly due to favourable climatic conditions like rain and humid weather. In severe infection, whole plant may be blighted and killed.	<ol style="list-style-type: none"> 1. Treat the seed with carbendazim @ 2g/kg of seed. 2. Use resistant varieties
2.	Grey mould (<i>Botrytis cinerea</i>): The fungus forms gray or dark brown lesions on leaflets, branches and pods. Lesions become covered with hairy sporophores of the fungus under high humidity and low temperature conditions. Growing tips and flowers are particularly susceptible to infection. The affected plant turns yellow and shedding of infected flowers takes place.	<ol style="list-style-type: none"> 1. Treat the seed with carbendazim @ 2g/kg of seed. 2. Spray chlorothalonil @ 0.2% 3. Crop rotation with non-host crops. 4. Use resistant varieties
3.	Dry root rot (<i>Rhizoctonia bataticola</i>): The tap root on pulling out is found to be dry and devoid of lateral and fixer roots. The dead root shows shredding of bark and is brittle towards tip. Very minute, dark brown sclerotia of fungus can be seen below the bark.	<ol style="list-style-type: none"> 1. Control measures same as for blight. 2. Follow crop rotation with non-host crops. 3. Seed treatment with biopesticide like <i>Trichoderma spp.</i> @ 5g/ kg of seed
4.	Collar rot (<i>Sclerotium rolfsii</i>): Affected young seedlings turn yellow and collapse, but older seedlings may dry slowly. Seedlings when pulled out show rotting at the collar region and downwards. White mycelium coating can be seen on the tap root of dried seedlings. Sometimes rape seed like sclerotia (1 mm in diameter) attached to mycellial strands around the collar can be observed.	<ol style="list-style-type: none"> 1. Drain out excess water from the field. 2. Uproot the affected plants at initial stages. 3. Use resistant varieties. 4. Seed treatment with carbendazim @ 2 g/kg of seed or seed treatment with biocides like <i>Trichoderma spp.</i> @ 5g/kg of seed.

<p>5.</p>	<p>Wilt (<i>Fusarium oxysporum</i> f. sp. <i>ciceri</i>): The disease attacks both seedlings and grown up plants which dry up retaining normal green color for some time.</p> <p>Uprooted plants show almost intact root system, but when split open show inner black discoloration in roots.</p>	<ol style="list-style-type: none"> 1. Drain out excess water from the field. 2. Uproot the affected plants at initial stages. 3. Use wilt resistant varieties. 4. Seed treatment with <i>Trichoderma</i> spp. @ 5g/kg of seed. 5. Seed treatment with carbendazim @ 2g/kg of seed or spraying of <i>Trichoderma viride</i> @ 4g/kg after 2 months of sowing.
<p>6.</p>	<p>Stem rot (<i>Sclerotinia sclerotiorum</i>): Usually appears in thick crop canopy. The disease is characterized by appearance of drying of branches or whole plant. Such dried branches show white mycelial growth or formation of black sclerotia.</p>	<ol style="list-style-type: none"> 1. Avoid excessive irrigation. 2. Seed treatment as in collar rot. 3. Spray chlorothalonil @ 0.2% or carbendazim + mancozeb @ 0.25% and repeat after 10-14 days if required.
<p>7.</p>	<p>Integrated disease management of <i>Ascochyta</i> blight, Stem rot (<i>Sclerotinia</i> sp.), Dry root rot and Wilt.</p>	<ol style="list-style-type: none"> 1. Deep ploughing during summer months shall minimize the inoculums. 2. Crop rotation with non host crops. 3. Seed treatment with <i>Trichoderma</i> spp. @ 5g/kg of seed or with carbendazim @ 2g/kg of seed followed by two sprays of chlorothalonil @ 0.2% or carbendazim + mancozeb @ 0.25 % (90 days and 120 days after sowing). 4. Avoid dense crop canopy.

Lentil

Among *rabi* pulses, lentil (*Lens esculantum*) is another important drought tolerant crop and can withstand severe winter to a great extent. However, yield level is very low because much attention has not been given on management of this crop. The yield can be improved considerably by following the recommended practices.

Climatic requirement: It require cold climate. It is very hardy & can tolerate frost and severe winter to a great extent as compared to gram.

Soil: Loam to clay loam is most suitable for lentil. Sandy soils are not good for this crop. Avoid growing of the crop on salt affected soil and/or with impeded drainage.

Varieties:

1. **L-4147** (Pusa Vaibhav): It is small seeded and resistant to rust. This variety matures in 134 days and has yield potential of 7.12q/acre
2. **PL-406** (Angoori): It is large seeded (3.9 g), resistant to rust. It requires 125-130 days for maturity and has yield potential of 6.80 q/acre
3. **DPL 15** (Priya): This variety is resistant to rust and has yield potential of 9.40q/acre.
4. **DPL 62** (Sheri): It is rust and wilt resistant variety having large sized seeds with yield potential of 9.40 q/acre.

The plants of these varieties grow erect and branch profusely. They possess good cooking quality, and are palatable and delicious. After the harvest of *kharif* crops, substantial area remains fallow during *rabi* owing to shortage of water, low soil fertility and other similar reasons. A major portion of this *rabi* fallow area can be conveniently brought under lentil during *rabi* season with a view to meet shortage of pulses, increase cropping intensity and to improve soil fertility.

Agronomic Practices

Field preparation: Field should be ploughed with soil turning plough followed by 2 to 3 operations with *desi* plough/disc harrow. Planking should be done after each operation.

Sowing time: The optimum time of sowing is from last week of October to second week of November but sowing can be extended up to first week of December. Delay in sowing may reduce the yield.



Seed inoculation: Inoculate the seed with appropriate *Rhizobium* culture before sowing for higher yields.

Fertilizer requirement: For efficient use of fertilizers, get the soil tested from nearest soil testing laboratory and apply recommended dose of fertilizers. However in its absence, the following fertilizer schedule can be followed:

Nutrient (kg/acre)			Fertilizers (kg/acre)		
N	P ₂ O ₅	K ₂ O	Urea	DAP	MOP
6	16	-	-	35	-

Drill whole quantity of DAP at the time of sowing. Phosphorus fertilizers give best result when inoculated with *Rhizobium*.

Seed rate: 16 kg seed is required for sowing in one acre area.

Method of sowing: The seed should be sown in lines 20 to 22 cm apart by *Kera* method. In paddy fields where excessive wetness does not permit good land preparation, sowing is often done by broadcast method using higher seed rate. However, line sowing is the best method.

Weed control: One or two hoeing and weeding between 20 and 40 days after sowing are beneficial for good yield. Weeds can be controlled effectively with pre-emergence application of pendimethalin @ 0.4 kg/acre along with one hand weeding at 60 DAS.

Irrigation: This crop is generally grown under rainfed conditions but if water is available, irrigate the crop at 45 to 50 days after sowing is beneficial to increase the branching and yield of the crop.

Mixed cropping: Lentil can be grown with barley in a seed mixture ratio of 4: 1. Lentil can be sown as relay crop under utera cropping system.

Harvesting: The crop should be harvested when pods are mature or plants start drying up otherwise shattering of seeds will take place.

Plant Protection

I. Insect pest and their management

Lentil pod borer: It causes heavy damage to lentil crop. To control this pest spray the crop with acetamiprid 20 SP @ 0.2g/litre of water or flubendiamide 39.35 SC @ 0.2 ml/litre of water or indoxacarb 14.5 SC @ 0.3-0.4 ml/litre of water at flower initiation and repeat the spray after 15 days of first spray if necessary.



II. Diseases and their Management:

S.no	Disease and Symptoms	Management
1.	Wilt (<i>Fusarium oxysporum</i> f.sp. <i>lentis</i>): The tap root gets infected leading to stunted growth and drying up of leaves. The fungus is seed and soil borne and causes more damage towards flowering and pod formation stage.	Seed treatment with carbendazim @ 2g/kg of seed or with <i>Trichoderma spp.</i> @ 5g/kg of seed
2.	Rust (<i>Uromyces fabae</i>): Under high humid conditions, yellow to brown rust pustules are formed on the leaves, pods and stem. Dark brown telia are formed mostly on the stem later in the season. In case of severe infection, plants dry up before seed setting.	Spray with propiconazole @ 0.1% at 10-12 days interval starting immediately at the appearance of disease. Use resistant varieties.
3.	Collar rot (<i>Sclerotium rolfsii</i>): The pathogen cause yellowish brown discoloration and rotting of tissue. The young seedling shows damping off symptoms. The plants infected at the advanced stage turn pale, gradually dry and droop. White feathery growth of the fungus generally associated with dirty white to brown colored sclerotia can be seen.	Seed treatment with carbendazim @ 2g/kg of seed. or with <i>Trichoderma spp.</i> @ 5g/kg of seed
4.	Root rot (<i>Rhizoctonia solani</i> and <i>Rhizoctonia bataticola</i>); The infected plants show dull green to pale yellow colour and wilt and dry up.	1. Use resistant varieties. 2. Seed treatment with carbendazim @2g/kg of seed or with <i>Trichoderma spp.</i> @ 5g/kg of seed

Peas

Peas (*Pisum sativum*) is an important pulse crop which usually serves both purposes of vegetables and pulses. For higher production of peas, production recommendations should be followed meticulously.

Soil: Peas thrive best on well-drained loamy soil.

Climatic requirements: Crop requires cool climate during vegetative phase. However, severe cold and frost adversely affect flowering and reduces fruiting.

Varieties:

1. **T-163:** It is a field pea variety (Pulse type). The plant is trailing type and produces white flowers. The pods are generally born in twins, the seed is round, smooth and white with greenish tinge. For seed the crop matures in 140-150 days. However, if desired the green pods can be collected after 120 days of sowing. This is the highest yielding variety.
2. **PG-2:** The variety is pulse type with medium to late maturity. Seeds are creamy, round to somewhat wrinkled, average yield is 6-8 q/acre.
3. **Rachna:** This variety is early maturing and resistant to powdery mildew with average yield of 4.8-6.0 q/acre.
4. **Prakash:** This variety is resistant to PM and tolerant to rust. It matures in 94-121 days and has yield potential of 8.40q/acre.
5. **Gomati:** It is suitable for late sown conditions, resistant to powdery mildew and tolerant to pod borer and stem fly. It requires 87-97 days for maturity and has yield potential of 9.20q/acre.
6. **IPF 5-19 (Aman):** It is resistant to powdery mildew and tolerant to rust with yield potential of 10q/acre.
7. **Pant P 42:** This variety is resistant to powdery mildew and moderately resistant to rust. It requires 131 days to mature and yield potential of 8.80q/acre.
8. **Pant P 74:** It is resistant to powdery mildew and moderately resistant to rust. It matures in 126-130 days and yield potential of 8.0q/acre.

Agronomic Practices

Field Preparation: 2-3 ploughings followed by planking to obtain fine seed bed.



Sowing time: Optimum time of sowing of peas is from mid-October to mid-November. Early sowing encourages wilt attack. Under dry land conditions 3rd week of October is optimum time however, sowing can be extended up to 1st week of December provided adequate moisture is available in the soil.

Seed rate: For pulse purpose use 30 kg/acre.

Fertilizer application: Apply the following fertilizer dose to the crop;

Nutrient (kg/acre)			Fertilizers (kg/acre)		
N	P ₂ O ₅	K ₂ O	Urea	DAP	MOP
6	16	-	-	35	-

Apply the whole quantity of fertilizer as basal dose. On light sandy soil even fertilizer N application can be increased to about 30 kg/ ha for obtaining better harvest.

Seed inoculation: Inoculation of pea seeds with *Rhizobium* culture (*Rhizobium leguminosarum*) will increase the yield of peas to the tune of 6-8%. In the absence of culture there shall be poor nodule formation. The *Rhizobium* and fungicide can be applied simultaneously. However, dual inoculation of field peas with *Rhizobium* +PSB has been found better than single inoculation with either *Rhizobium* or PSB. Also dual inoculation resulted in saving of P fertilizer by 25%. The dual inoculation of *Rhizobium* +PSB along with 75% recommended dose of P has been found more remunerative.

Application Rate:

- 1) *Rhizobium* @ 20g/kg of seed in jaggery solution and shade dried
- 2) PSB @10g/kg of seed in jaggery solution and shade dried

Method of sowing: The crop should be sown in rows 30 cm apart and plant to plant distance of 10 cm should be maintained.

Interculture: Field should be kept free of weeds by giving two hand weedings and hoeings after four and eight weeks after sowing.

Irrigation: For field peas, if water is available then irrigate the crop before flowering and at pod formation.

Mixed cropping: Field peas can be sown mixed with barley or wheat in 1:2 seed mixture ratio. In this way barley/ wheat helps the peas in keeping the vines off the ground and peas help by fixing nitrogen which gives higher returns in comparison to pure crop of barley/wheat or peas. The mixed cropping is safe guard against total failure in dry farming areas where crop is grown on conserved moisture.



Harvesting: If peas are grown for disposal as green pods, then vegetable type of peas should be grown. In case of pulse type, the crop should be harvested when the leaves turn yellowish in color and start shedding. Care should be taken not to over seat or over trample the crop, which may damage the seed coat and reduce quality.

Plant Protection

I. Insect pest and their Management

S.no	Pests and symptoms	Control measures
1.	Pea Maggot (<i>Melanagromyza phaseoli</i>) It causes heavy damage to early sown pea crop. The maggot bores the underground portion of stem which causes poor stand of the plants.	Cartap hydrochloride 4G @ 8kg/acre after final ploughing before sowing.
2.	Pea leaf miner: Larvae feed by making tunnels in leaves.	Spray the crop with dimethoate 30 EC @ 2 ml/L of water. This will control thrips and aphids also.
3.	Pea pod borer: It is serious pest in temperate region. The larvae bore into the pod and eat developing seed.	Spray the crop with chlorpyrifos 20 EC @ 2ml/L or cypermethrin 10 EC @ 1ml/L or acetamiprid 20 SP@ 0.2ml/L of water
4.	Pea thrips: Causes damage to young crop by sucking cell sap.	Same as in pea leaf miner
5.	Pea aphid: Sucks cell sap, leaves turn pale and dry.	Same as in pea leaf miner.

Note: No chemical insecticides spray as more than 50% of the insect pest population is managed by their predator and parasitoid. Application of biorationals like Neem only should be done for managing key insect pests.

II. Disease and their Management

	Pests and symptoms	Control measures
1.	Powdery mildew (<i>Erysiphe pisi</i>): White floury patches appear on both sides of leaves as well as on pods, stem etc.	Spray the crop with wettable sulphur @ 0.25% or with hexaconazole @ 0.1%



2.	Wilt and Root rot (<i>Fusarium oxysporum</i> f. sp. <i>lisi</i> & <i>Rhizoctonia spp.</i>): Roots start rotting and plants show yellowing of lower most leaves followed by wilting.	Treatment with carbendazim @ 2 g/kg of seed or seed treatment with <i>Trichoderma spp.</i> @ 5g/ kg of seed.
3.	Blight (<i>Ascochyta spp/Alternaria spp.</i>): <i>Ascochyta spp.</i> produces lesions on leaves, stem and pods. The lesions are slightly sunken showing concentric rings with pycnidia, whereas, <i>Alternaria spp.</i> produces lesions with indistinct concentric rings.	Treatment with carbendazim @ 2 g/kg of seed or spray with azoxystrobin @ 0.1%
4.	Foot rot (<i>Phoma medicaginis</i> var. <i>pinodella</i>): Lesions are produced at foot region with wider streaks of blue-black color on leaves.	<ol style="list-style-type: none"> 1. Crop should be planted in well drained soil. 2. Crop rotation with non host crops 3. Seed treatment with azoxystrobin @ 1.5 g/kg of seed or carbendazim @ 2 g/kg of seed
5	Rust (<i>Uromyces fabae</i>): Rust colored lesions are produced on lower leaves, stems and tendrils. In advanced infection, diseased leaves fall off prematurely.	<ol style="list-style-type: none"> 1. Field sanitation to destroy crop debris. 2. Spray the crop with bayleton @ 0.05%, or calixin @ 0.1% as the disease appears and repeat the same after 10 days, if required.

RAPESEED - MUSTARD

Oils are the principle source of energy, which can be met by growing oilseed crops. We seek to provide a minimum of 15 g per head per day through oil seeds. The Jammu and Kashmir UT is deficient in oilseed production by more than 70% of its total requirements. Rapeseed mustard comprises of toria (*Brassica rapa*), raya (*Brassica juncea*), gobhi sarson (*B. napus*), taramira (*Eruca sativa*) and african sarson (*B. carinata*). Toria and taramira are predominantly cross pollinated where as raya, gobhi sarson and African sarson are broadly self pollinated. In trade, toria, gobhi sarson and taramira are categorized as rapeseed while raya and african sarson are categorized as mustard. Toria, gobhi sarson and african sarson are sown exclusively under irrigated conditions where as raya can be grown under both irrigated and rainfed conditions. Taramira is grown as rainfed crop only.

These oil seeds can be grown under both irrigated and rain fed conditions. If pure crop of mustard is sown, plant protection measures against aphids can easily be taken which ultimately increase the yield. Strip cropping with wheat is recommended for increased production of wheat and mustard in wheat fields.

Shortage of oilseeds can be overcome by diversification of cropping pattern in *rabi* (both under irrigated and unirrigated conditions). Some of wheat areas if sown with mustard can give better returns because this crop requires less fertilizers, irrigation and labour than wheat in irrigated area. Some promising crop rotation is Summer Moong-Toria-wheat, *Kharif* fodder-Toria-Wheat, *Kharif* fodder-Toria+ Gobhi sarson-Sumice-Gobhi Sarson-Moong.

Mustard

Climatic requirements: The crop requires cool climate during early stages (15 to 25^o c) of crop growth. For maturity, higher temperature is required.

Soil requirement: It thrives well under varied soil conditions both under heavy and lighter soil types. The crop is slightly tolerant to salt but not to impede drainage. It is mostly grown under rainfed conditions but can be grown with advantage under limited irrigation.

Recommended varieties with time of sowing:

S.No.	Growing conditions	Variety and its characteristics	Sowing time
1.	Sub-tropical	Pusa Bahar: This variety is recommended for general cultivation under rain-fed and	Early sowing (1 st week of September to 30 th September)

		<p>irrigated areas of Jammu region. It matures in 108-110 days and the average yield is 4q/acre. It contains 43.0% oil content.</p> <p>Pusa Basant: This variety is also recommended for rain-fed and irrigated areas of Jammu region. It is early maturing variety and takes 108 days to mature. The average yield is 4.25q/acre and contains 42.0% oil content.</p> <p>Pusa Mustard-25: This variety is recommended for general cultivation in Jammu region. It is early maturing variety of <i>Brassica juncea</i> can be high profitable substitute for toria. It contains 39.7% oil and matures in 100-107 days. Its average yield is 4.5 q/ acre. Late sown wheat can also be taken.</p>	
		<p>Jm-135 (Jammu Mustard-135):- This variety is recommended for general cultivation in Jammu region under timely sown irrigated conditions. It is high yielding variety with seed size of 5.0-5.8g. It contains 41.5% oil and matures in 142 days. Its average yield is 7.8 q/ acre.</p> <p>Giriraj (DRMRIJ-31):- This variety is recommended for general cultivation in Jammu region under timely sown irrigated conditions. It is high yielding variety with seed size of 5.0-5.8g. It contains 40.2% oil and matures in 143 days. Its average yield is 7q/ acre.</p>	<p>Timely sown conditions i.e. (2nd fortnight of October)</p> <p>Note: For realization of higher yields of Indian mustard the sowing must be done between 15th to 25th October beyond which the crop yield reduces significantly</p>

		<p>RH-749:-This variety is recommended for general cultivation in Jammu region under timely sown irrigated conditions. It is high yielding variety with seed size of 5.5-6g. It contains 40.50% oil and matures in 146 days. Its average yield is 7.75/acre.</p> <p>RSPR-69: This variety is recommended for general cultivation in Jammu region under timely sown irrigated conditions. It is high yielding variety with oil contains 41 % and matures in 135-140 days. Its average yield is 7.5-8 q/acre.</p> <p>NRCDR-2: This variety is recommended for general cultivation in Jammu region. It is high yielding variety with seed size of 5.0-5.8g. It contains 40.2% oil and matures in 141 days. Its average yield is 6.68q/acre. It has high number of primary branches, high pod intensity and lodging resistance.</p> <p>RSPR-01: This variety is recommended for general cultivation in Jammu region. It is high yielding variety with oil content of 40.0%. The average yield is 7.75-8 q/acre. It matures in 140-150 days.</p> <p>RSPR-03: This variety is recommended for general cultivation in Jammu region. It contains oil content of 40.0% and matures in 145 days. The average yield is 6-7.75q/acre.</p>	
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	<p>Kranti: This variety is recommended for general cultivation in Jammu region. It contains oil content of 40.0% and matures in 125-130 days. The average yield is 6-7.5q/acre. This variety is tolerant to <i>Alternaria blight</i> than Varuna and more resistant to downy mildew and white rust.</p> <p>RL-1359: This variety is recommended for general cultivation in Jammu region. This variety is tolerant to aphid and has oil content of 43.0%. Its average yield is 7.75-8.25q/acre. It matures in 147 days.</p> <p>Varuna: This variety is recommended for general cultivation in Jammu region. It is high yielding variety with seed size of 5.0-6.5g. Its average yield is 8-8.5q/acre. It matures in 135-140 days and contains 43.0% oil content.</p> <p>Pusa Bold: This variety is recommended for general cultivation in Jammu region. It is high yielding variety with seed size of 6.0-7.0g. It contains oil content of 42.0% and matures in 145 days. Its average yield is 7.5q/acre.</p>	
	<p>RH-406: This variety is recommended for rainfed timely sown conditions of plain zones of Jammu, Kathua, Reasi, Rajouri, Samba and Udhampur districts in second fortnight of October. It contains 40 % oil content and matures in 140-145 days. Its average yield is 7.5q/acre.</p>	<p>Timely sown rainfed conditions (second fortnight of October)</p>

		RH-30: This variety is recommended for rain fed and irrigated areas of Jammu region. It is high yielding variety with seed size of 5.0-6.5g. It contains oil content of 39.0% and matures in 130-135 days. Its average yield is 6.4-8q/acre. It is suitable for late sown conditions.	
		NRCHB-101: This variety is recommended for cultivation under late sown conditions in irrigated and rainfed areas of Jammu in first fortnight of November, Kathua, Rajouri, Reasi, Samba and Udhampur districts. It contains 39.5 % oil content and matures in 132-135 days. Its average yield is 7.5-8q/acre.	Late sown conditions (First fortnight of November)
2.	Intermediate (up to 3000ft altitude where snowfall is not experienced)	Kranti Varuna RH-30	2 nd fortnight of October
3.	Temperate area (Above 3000 ft altitude)	KOS-1: This variety is recommended for general cultivation in higher altitude of Jammu region under rainfed conditions. It contains 44% oil content. Its average yield is 10q/ha and resistant to snow and frost. KS-101 (Gulcheen): This variety is recommended for temperate areas of Jammu. It contains 40-45% oil content. Its average yield is 6-8q/acre and resistant to snow and frost.	From end of September to 15 th of October

If mustard sowing is delayed and more nitrogen and irrigations are used to force its growth, white rust and downy mildew complex seriously attack and reduce crop yield.



Agronomic Practices

Field preparation: Fine seed bed is required to ensure good germination. The soil should be thoroughly pulverized so that fine tilth is obtained. After each operation the land should be planked to conserve moisture. Soil should be free of stubbles and clods. However, mustard (Raya) can be successfully cultivated with zero till drill after rice harvesting, weed growth can be checked with paraquat @ 500ml per acre using 200 litres of water.

Seed rate: 1.75-2.0kg/acre is required for *Brassica juncea* (Raya) and 2.5 kg/acre for *B. campestris* (KOS-1 & KS-101).

Method of sowing: The seed should be sown under proper moisture conditions. At the time of sowing mix some sand with the seed to increase the bulk for uniform distribution. Place fertilizers by *pura* method and sow the seed 30 cm apart in rows and 10-15cm from plant to plant. The seed should be sown shallow not more than 3 - 4 cm deep.

Interculture and weed control: Hoeing must be done within 30 days of sowing to control weeds and conserve moisture. Maintain plant geometry of 30 cm x 10 cm at the time of first hoeing by thinning.

Weeds in rapeseed and mustard crop cause significant reduction in crop yield to an extent of about 30-60 percent. The common weeds which severely infested the rapeseed and mustard crop are *Medicago denticulata* (Clover), *Chenopodium album* (Bathua), *Rumex retroflexus* (Jangli palak), *Ranunculus arvensis* (Butter cup), *Fumaria parviflora* (Gajri), *Euphorbia heliscopa* (Bara dudhi), *Cyperus rotundus* (Motha) and *Avena Ludovincina* (wild oat).

For effective control of weeds in mustard apply fluchloralin or trifluralin @ 0.300 kg a.i./acre as pre plant incorporation (PPI) or Pre emergence application of pendimethalin @ 0.400 kg a.i. or oxyfluorfen @ 60 ml/acre (0.06 litre/acre) must be made after dissolving in 500-600L water. The herbicide should be evenly sprayed on the soil surface within 24 hours of sowing of the crop preferably in the evening hours.

Fertilizer requirement: Apply fertilizers as per following schedule:

Nutrient (kg/acre)				Fertilizers (kg/acre)			
N	P ₂ O ₅	K ₂ O	S	Urea	DAP	MOP	Gypsum
24	12	6	8	43	26	10	40

Half of N and full dose of P₂O₅ and K₂ O₅ should be drilled at the time of sowing and remaining half N should be top dressed at first irrigation. Mustard



crop responds remarkably well to sulphur. Wherever possible, single super phosphate may be used as source of P_2O_5 which will supply sulphur as well, otherwise apply gypsum.

Mixed cropping: It should never be sown mixed with wheat or barley and should be sown in strip ratio of 8: 1 i.e. 8 rows of wheat and 1 row of mustard. By sowing mustard and wheat in strips, shading effect of mustard on wheat will be minimum and plant protection measures on mustard crop will be easier. Toria can also be grown as mixed intercropping with toria+gobhi sarson. Toria in mid September in alternate rows 22.5cm apart or sowing toria by broadcasting and gobhi sarson in lines 45cm apart uses 1 kg seed/acre for each crop. The Gobhi sarson can be sown as per recommended time.

Moisture Stress Mitigation in Indian Mustard using Agrochemicals

In case of prolonged dry spell, the foliar application of 0.05 % thio-urea spray at 50% flowering stage followed by 50 % siliquae filling stage by mixing 0.5 g thio-urea in one litre of water (7.5 grams in 15 litre pump) with a knapsack sprayer with flat fan T-jet nozzle using a spray volume of 700 litres per hectare must be sprayed between the period of moisture stress which coincides between 50-60 and 90-100 days after sowing

Irrigation: Mustard has been found to do well under protected irrigation. One irrigation at the time of thinning and other at siliquae development stage, (If there is no rainfall) has been found to give higher yield of this crop. If there are timely rains, there is no need of irrigation.

Harvesting: To avoid shattering, the crop may be harvested immediately when siliquae turn yellow.



Gobhi Sarson

Gobhi sarson is a high yielding *rabi* oilseed crop, suitable growing both under irrigated and rainfed conditions. Its leaves are thick smooth, sweet in taste, and give quality sag. Its initial growth is slow and plants remain in vegetative phase till late January. As such crop escapes frost and plants do not lodge easily. It is resistant to white rust and has about 44.5% oil content. It takes about 160 days for maturity and yields about 15-20 q/ha. For getting higher yield, following production recommendations may be followed.

Varieties:

1. **JGS-123 (Jammu Gobhi Sarson-123):-** This variety is recommended for Jammu region, its average yield is 7-8 q/acre, oil content is 42.49% and seed size is 3.0 to 4.8 g.
2. **GSL-1:** This variety is recommended for general cultivation in Jammu region. Its leaves are thick, smooth and sweet in taste. Its initial growth is slow and plants remain in vegetative phase till early February. It matures in 160 days. Its average yield is 6-8q/acre. It contains 44.5% oil content.
3. **GSL-2:** It is first ever atrazine herbicide resistant variety of gobhi sarson. It is recommended for timely sown and irrigated conditions. Its average yield is 6-8q/acre and contains 44.5% oil content.
4. **DGS-1:** This variety is recommended for general cultivation in Jammu region. This is high yielding variety with profuse branching and intense pod-bearing capacity. Its leaves are thick, smooth and sweet in taste. It contains 44% oil content.
5. **GSC-7:** This variety is recommended for general cultivation in Jammu region. It is high yielding variety with seed size of 3.7-4.2g. It contains 40.7% oil and matures in 160 days. Its average yield is 7.5-8q/acre.
6. **RSPN-25:** It is recommended for cultivation in Jammu plains. It has average yield of 15-6.4q/acre with oil content of 40 percent and maturity duration of 140-150 days.

Agronomic Practices

Land preparation: Same as described for mustard.

Seed rate: 2kg/ acre

Method of sowing: The seed should be sown under proper moisture conditions. At the time of sowing mix some sand with seed to increase the bulk for uniform



distribution. Seed should be sown in lines 40-50 cm apart at a depth of 3 cm. The crop should be thinned 10 days after germination maintaining plant to plant distance of 10 cm.

Time of sowing: It should be sown during first fortnight of October as a pure crop. When sown as an intercrop with toria it should be sown by third week of September under sub-tropical conditions (both irrigated and rainfed). Toria can be broadcasted and gobhi sarson can be sown in lines 40-45 cm apart.

Transplanting conditions: For transplanting, 60 days old seedlings may be used in the last week of November. The nursery sowing may be done accordingly in month of September in an area of about 500 m² for transplantation in 2.5 acre area. 12 kg of urea and 10 kg SSP may be mixed in the nursery and seed may be broadcasted @ 1 kg / 500m²

Fertilizers: Apply fertilizers as per schedule given below:

Situation	Nutrient (kg/acre)				Fertilizers (kg/acre)			
	N	P ₂ O ₅	K ₂ O	S	Urea	DAP	MOP	Gypsum
Irrigated	24	16	8	8	38	35	13	40
Unirrigated	20	12	6	8	33	26	10	40

Under irrigated conditions, apply half dose of N and whole P₂O₅, K₂O and sulphur as basal dose and remaining N as top dressing after first irrigation whereas under unirrigated conditions 2/3rd of N, full dose of P₂O₅, K₂O and sulphur should be applied as basal & remaining 1/3rd after rains between 20-30 days of sowing.

Time and method of fertilizer application

- i) Prefer phosphorus from single super phosphate. If this fertilizer is not available, apply gypsum @ 40 kg/ha particularly in sulphur deficient soils along with the nitrogenous and phosphorus fertilizers at sowing.
- ii) When gypsum is not available in the market then in sulphur deficient soils sulphated fertilizers (13:33:0:15; N:P₂O₅:K₂O:S) may be applied as an alternate source of sulphur to mustard.

Weed control: Same as for mustard.

Harvesting and threshing: The crop is ready for harvest when pods turn yellow. Gobhi sarson is harvested in first fortnight of April. If any delay is done in harvesting there will be heavy loss due shattering of seeds. Thus, the crop should be harvested at its proper time. The harvested plants should be staked for 7-10 days before threshing with head upward.



Plant Protection

I. Insect pest and their Management

S.no	Pests and symptoms	Management practices
1.	Mustard Aphid (<i>Lipaphis erysimi</i>): These are green coloured insects called plant lice become innumerable covering the inflorescence and pods. They suck plant sap with the result plants remain stunted, pods shrivel and seeds do not develop	<p>A) Cultural Control</p> <ol style="list-style-type: none"> 1. Early sowing of mustard crop preferably by first fortnight of October. 2. Use recommended dose of fertilizers 3. Basal application of MOP (40kg/ha) in addition to the recommended dose or neem cake @ 200kg/acre. <p>B) Biological control practices: Conserve potential biocontrol agents like parasitoid, ladybird beetles, <i>Syrphid larvae</i> & <i>Chrysoperla</i>. Pest defender ratio of 2:1 may be useful to avoid application of insecticides. When mustard aphid population crossed ETL (50-60 aphids per 10 cm twig), spray 2.5% castor seed extract or cannabis leaf extract.</p> <p>C) Chemical Control</p> <ol style="list-style-type: none"> 1. Combination of chlorpyrifos+acetamiprid 0.05% is highly effective against mustard aphid. 2. Spray chlorpyrifos 20 litre of water or methyl demeton 25EC @ 1ml/litre of water or dimethoate 30 EC @ 2 ml/litre of water or 2.5% castor seed extract or cannabis leaf extract. 3. For economical control, apply cartap hydrochloride 4G @ 8 kg/acre at flower initiation stage or when first aphid colony is noticed. Broadcast granules and give light irrigation. 4. Apply insecticides when the economic threshold level of 40- 45% plant infestation or 50-60 aphids per 10 cm central shoot are observed.
2.	Mustard Sawfly (<i>Athalia lugens-proxima</i>): The larvae attack young crop, bite holes and skeletonize leaves completely, such plants do not bear seeds.	Spray the crop with chlorpyrifos 20 EC @ 2 ml/litre of water or cypermethrin 10 EC @ 1-2ml/litre or acetamiprid 20 SP @ 0.2 g/litre of water

Minor Insect Pests

S.no	Pests and symptoms	Management practices
1.	Flea beetle (<i>Phyllotreta cruciferae</i>); The larvae mine the roots and adults feed on leaves and make innumerable holes. Badly damaged leaves dry & plants die in early stage.	Control same as for Sawfly.
2.	Leaf Miner (<i>Phytomyza atricornis</i>); Larvae feed by making tunnels into leaves and cause huge damage	Control same as in mustard aphid.
3.	Hairy caterpillars: They feed on leaves, young shoots and green pods.	Collect and destroy congregating caterpillars Spray the crop with chlorpyrifos 20 EC @ 2 ml/litre of water or cypermethrin 10 EC @ 1-2 ml/litre of water.
4.	Painted bug (<i>Bagrada cruciferarum</i>) Both nymphs and adults suck cell sap from leaves and pods which gradually wilt and dry	Spray the crop with Malathion 50 EC @ 2 ml/litre in 240 L of water/acre

*Spray the crop meant for Saag with 0.05% malathion 50EC.

II. Diseases and their Management

S.no	Disease and symptoms	Management
1.	Alternaria blight (<i>Alternaria</i> spp) Brown circular spots on stems and branches, Black spots with concentric rings appear on leaves.	1. Treat the seed before sowing with carbendazim @ 2 g/kg of seed 2. Destroy disease debris and spray the crop with carbendazim + mancozeb @ 0.2%.
2.	White rust (<i>Albugo candida</i>) and Downy mildew (<i>Peronospora parasitica</i>). White rust pustules and downy grey growth develop mostly on lower surface of leaves. The diseases cause systemic infection in flowering branches, which become malformed and sterile (stag head).	1. Treat the seed before sowing with metalaxyl @ 1.5g/kg of seed 2. Destroy disease debris and spray the crop with metalaxyl + mancozeb @ 0.25%. 3. Timely sowing (first fortnight of October) is helpful in avoiding disease incidence. Use resistant varieties of rape seed, mustard and Gobhi sarson.

Torja

Varieties:

- i) **RSPT-1:** It takes 75-85 days to mature. Because of its early maturity, it fits well in torja wheat crop rotation. It gives an average yield of 3q/acre. Its oil content is 39.5%.
- ii) **RSPT-2:** It is early maturing (65-75 days) and one week earlier in maturity than RSPT-1. It has yield superiority of 12.6 to 27.9% over local varieties (2.6-3.4q/acre). It contains 42.7% oil and is recommended for Jammu, Kathua and some parts of Udhampur District.
- iii) **RSPT-6:** The variety is recommended for general cultivation in Jammu, Samba, Kathua and some parts of Udhampur and Reasi District. It is early maturing (80-85 days) variety. It gives an average yield of 4.8q/acre. Its oil content is 42.4%.

Soil: Torja does well under loamy and heavy soils.

Agronomic Practices

Land preparation: Fine seed bed is required to ensure good germination. First ploughing with soil turning plough followed by 2-3 ploughings with disc harrow/trephali/desi plough will give fine tilth. Planking should be followed by each ploughing.

Seed rate: 2 kg of seed is required to sow one acre area.

Fertilizer application: Following generalized fertilizer dose should be followed:

Nutrient (kg/acre)			Fertilizers (kg/acre)		
N	P ₂ O ₅	K ₂ O	Urea	DAP	MOP
12	7	4	20	16	7

Apply whole quantity of DAP + MOP and half of N at time of sowing and remaining half of N should be top dressed 25-30 days after sowing.



Time of sowing: First week of September is the optimum time for sowing toria. However, its sowing should be completed by the end of September after harvest of maize or paddy so that wheat sowing may not be delay after toria harvest.

Method of sowing: The seed should be sown under proper moisture conditions. At the time of sowing, seed is mixed with some quantity of sand to increase the bulk, which facilitates uniform distribution of seed. Fertilizer should be applied through *pura* and seed should be sown behind the plough. The crop rows should be spaced 30 cm apart and seed should not be sown deeper than 3 to 4 cm. Thinning of plants should be done 3 weeks after sowing, maintaining plant to plant distance of 10-15 cm.

Interculture: One weeding or hoeing should be given after three weeks after sowing.

Irrigation: First irrigation one month after sowing and second at siliquae formation stage.

Plant Protection: Plant protection same as for Gobhi Sarson.

Harvesting: The crop is normally ready for harvesting when pods turn yellow. The harvested plants should be stacked for 7-10 days before threshing.

Safflower

Climatic requirements: Safflower (*Carthamus tinctorius*) is a cool season crop, optimum temperature required for germination is 15.5°C. Seedlings are tolerant to low temperature. The high temperature at flowering stage of the crop is detrimental to the crop yields. However, the most favourable day temperature suitable for flowering of the crop is 24-32 °C which helps in higher seed yields. Frost is harmful to the crop. Excessive rainfall or humidity increases damage due to fungal diseases. Water logging due to poor drainage or prolonged rains can cause substantial reduction in yield.

Soil: Being drought tolerant, it is cultivated on all types of soils including sandy soils, but the crop is best suited to deep well drained fertile soils with high water holding capacity and neutral pH.

Varieties:

1. A-l: Moderately tolerant to wilt, aphids. Oil content is 31%. Maturity days 130 days. It has potential yield of 6q/acre.
2. A-300: Yield Potential 4.4q/acre. Matures in 125 days. Oil content is 31%
3. Nera: Yield Potential 5.6q/acre in rainfed conditions and 8.8q/acre in irrigated situations. Oil content is 31% and matures in 127 days.
4. JSF-l: The seed of the variety is bold and white, bushy plant with 10-15 branches. Oil content is 31%. Non lodging and fertilizer responsive. Suitable for early to late sowing. Require 135-140 days for maturity and potential grain yield 6.8q/acre.

Agronomic Practices

Land preparation: One deep ploughing with soil turning plough and 2 to 3 harrowings with *desi* plough followed by planking is sufficient. Care must be taken to ensure enough moisture for seed germination at time of sowing.

Sowing: Healthy seeds of improved varieties should be selected for sowing. First week of October to first week of November is the normal planting time of the crop. A spacing of 45 cm should be maintained between two rows with plant to plant distance 20-25 cm while seeds may be drilled 5-6 cm deep in furrows at a seed rate of 6-8 kg/ acre.

Manures and fertilizers: On sandy soils apply 6-8 tonnes of compost or FYM at the time of last harrowing. In areas where irrigation is possible 16 kg N, 16 kg P₂O₅ and 8 kg K₂O/ha should be applied through 22 kg urea, 35 kg DAP and 13 kg MOP respectively at the time of sowing. Apply fertilizer by *pora* and seed by *kera* method.

Weed control: Weed growth should be checked in the early stages of growth.



Two weeding or hoeing should be done 20 and 40 day after sowing which help in better weed control as well as development of roots. When the plants have developed the central flowering head may be topped to promote branching, flowering and seed production.

Water management: The crop is capable of obtaining moisture from lower levels not available to the majority of crops and can thus tap sub-soil moisture. Although the crop is grown without irrigation over the major portion of area as a large scale commercial crop but highest yields are obtained under irrigated conditions. The flowering and grain filling stages are more sensitive to water stress conditions. One irrigation after 30 days after planting helps in better growth of the crop.

Harvesting and threshing: Safflower matures in about 120-140 days. At maturity the leaves and stem assume yellow color. Harvesting should be done in morning hours to avoid the breakage of plant parts and troubles due to spines. The ripe plants are either cut or pulled out, stacked for few days to dry, threshed by beating with sticks and resulting material is winnowed to obtain clean seeds.

Rotations and mixed cropping: The crop is mostly grown as mixed crop with wheat, barley, gram, lentil etc. Three rows of safflower being planted after every 9 or 12 or more rows of main crop. Safflower is sown as a border crop in wheat, barley, and gram in order to prevent trespass by stray cattle. As a pure crop it can be rotated with green and black gram.

Plant Protection

I. Insect pests and their Management

S.no	Pests and symptoms	Management practices
1.	Aphids (<i>Dactynotus carthamus</i>): Both nymphs and adults suck cell sap from leaves and buds causing reduction in yields. The most sensitive stages are pre-flowering and flowering stages.	Give first spray within 1 or 2 weeks after aphids are noticed and repeat at interval of 15 days on need basis. Spray dimethoate 30 EC @ 1.5-2 ml/litre water or oxydemeton methyl 25 EC @ 1ml/litre of water
2.	Polyphagus pests: Some time gram pod borer, semi looper, cutworm and other caterpillars assume serious proportion and cause excessive defoliation and damage to young and developing buds.	Same as in chickpea

II. Diseases and their Management

S.no	Disease	Management practices
1.	Alternaria blight (<i>Alternaria carthami</i>): Small brown to dark brown concentric spots appear on foliage and finally tend to short hole formation on leaves.	<ol style="list-style-type: none"> 1. Treat the seed before sowing with carbendazim @ 2g/kg of seed 2. Destroy disease debris and spray the crop with chlorothalonil @ 0.2% or carbendazim + mancozeb @ 0.25%
2.	Rust (<i>Puccinia carthami</i>): Initially orange yellow pustules representing <i>pycnia</i> appear on cotyledons and leaves. Later on they turn brown to black as telia.	<ol style="list-style-type: none"> 1. Use disease free seeds. 2. Spray chlorothalonil @ 0.2% or triadimefon @ 0.1% at the disease initiation.
3.	Root rot (<i>Phytophthora</i> sp): Water soaked spots, softening of cortical tissue of lower stems and brown to greenish black discoloration of root cortex tissue. Finally wilting symptoms are observed.	<ol style="list-style-type: none"> 1. Provide proper drainage to field. 2. Treat the seed with metalaxyl @ 1g/kg of seed. 3. Remove and destroy affected plants
4.	Wilt (<i>Fusarium</i> spp.): Yellow discoloration of foliage followed by wilting, epinasty and vascular browning.	<ol style="list-style-type: none"> 1. Provide proper drainage to field. 2. Treat the seed with carbendazim @ 2g/kg of seed. 3. Remove and destroy wilt affected plants by burning.

Linseed

Linseed (*Linum usitatissimum*) is grown in our country under both rainfed and irrigated conditions. It is grown as an important *rabi* season oilseed crop, next to rapeseed and mustard for its economic importance. Farmers are aware of its value addition and utility in terms of dual purpose cultivars (oil and fiber). Every part of the linseed plant is utilized commercially, either directly or after processing. Seed contains 33 to 47% of oil content. Hence it is utilized in the manufacture of paints, oil cloth, varnish, pad-ink, printed ink, linoleum etc. Linseed is globally cultivated for its fiber and is called flax. Fiber is used for the manufacture of linen.

Soil and its preparation: Linseed can be profitably raised in places where the other crops may fail. Hence, it is often grown on marginal and sub-marginal rain-fed soils as pure crop, mixed crop and intercrop. Linseed can be raised in almost all types of soils, where sufficient moisture is available, but it also does better on heavier soils having greater water-retention capacity. However, it grows best on well drained loam to clay loam soils rich in humus.

Climate requirement: Linseed is a cool season crop. The temperature during the vegetative development of the crop should be moderate or cool. The crop is well suited to tracts of low rainfall and is generally raised where the average annual rainfall ranges from 45 to 75 cm. at the time of flowering, frost is very harmful to the crop.

Varieties

1. LC-2063: The LC-2063 variety of linseed has bold seed size and possesses oil content 41percent with an average yield of 4.9q/acre of seed.
2. LC-54: The plant matures in 155-160 days and the crop produces 4.8-6q/acre of seed. This needs irrigation. The crop resistant to powdery mildew, rust and wilt.

Agronomic Practices

Land preparation: Land should be ploughed 2-3 times followed by 2-3 harrowings to bring a fine tilth. To conserve moisture, it is advisable to create soil mulch with the help of a hoe after each good shower.

Seed rate: 10kg/acre

Method and time of sowing: Linseed is usually sown by broadcast or by drilling in rows. An inter-row spacing of 20-30 cm and intra-row spacing of 7-10 cm are ideal. The time of sowing varies from early October, to mid-November. Rainfed crop requires early sowing. Depending upon the soil moisture, the seed should



be placed 2-3 cm below the soil. However, shallow sowing is always advantageous if there is adequate moisture in the soil.

Under irrigated conditions, the crop must be sown in the second fortnight of October preferably before 20th October for realization of higher yield. The potential yield of 4-4.8 quintals can be obtained after following all standard package and practices for the crop

Manure and fertilizers: Linseed crop is generally grown without manuring. Application of 3.2-4.0 tonnes of FYM or compost/acre at the time of final field preparation is beneficial. In Jammu region, crop is raised with use of FYM and castor cake. However, improved varieties of linseed respond to fertilizers.

Fertilizer requirement: Apply fertilizer as per the following schedule:

Nutrition (kg/acre)			Fertilizers (kg/acre)		
N	P ₂ O ₅	K ₂ O	Urea	DAP	MOP
20	12	8	33	26	13

Under irrigated condition, half the dose of N with full amount of P and K should be applied as basal at sowing. Remaining N is applied in two splits, at 30 and 60 DAS.

Cropping systems: Linseed is mostly taken under maize-linseed cropping system in the rainfed tracts of our UT.

Harvesting and threshing: The crop takes about 130-150 days to mature. At maturity, the leaves become dry, capsule turns brown and the seed becomes shiny. After harvesting, bundle the plants and leave them on threshing floor for 4-5 days for drying. Threshing is done by beating the plant with sticks or trampling by bullocks.

Agronomic Management

Management practice	<i>Kharif</i>	<i>Rabi</i>
	Maize	Linseed
Date of sowing	11 th June	20 th October
Method of sowing	Ridge sowing	Flatbed method
Seed rate	8 kg/acre	10 kg/acre
Fertilizer Dose (N:P ₂ O ₅ : K ₂ O kg/ha)	36:24:12	20:12:8
Irrigations	3	2
Harvesting	9 th September	30 th April

FODDER CROPS

Berseem

Berseem (*Trifolium alexandrinum*) provides high yield of very nutritious and palatable fodder through repeated cuttings throughout winter and early summer in sub-tropical conditions.

Climatic requirements: Berseem thrives best in sub-humid and moderately cool climate.

Varieties:

1. Mescavi: This variety is recommended for Jammu region due to fast regrowth in early period and has wide adaptability. The green fodder yield potential of the variety is 280q/acre.
2. Pusa Giant: This variety is tolerant to winter and frost, bears winter hardiness. The green fodder yield potential of the variety is 270q/acre.
3. BL-1: It is recommended for Jammu region as it is quick growing and early maturing variety. Its first cut is ready by about a week earlier and also supplies fodder a week later than Mescavi. It has green fodder yield potential of 336q/acre.
4. Wardan: This is promising variety for seed and fodder production. It is tolerant to bacterial wilt and other diseases and has fodder yield potential of 290q/acre.

Soil type: It performs best on medium to heavy soils. Avoid sowing on sandy soils, clay loam is supposed to be best for its cultivation.

Agronomic Practices

Land Preparation: Berseem seeds are very small in size, hence require very fine seed bed. Therefore 3-4 ploughing each followed by planking will be suitable for proper seed bed. Small plots of 20 to 30 square metres will be suitable to facilitate proper irrigation supply which ensures uniform germination.

Sowing time: It may be sown between mid-September to end of October. First fortnight of October is the optimum sowing period.

Seed rate: Use 10-12 kg of seed/acre. It is economical to mix 0.4 kg of mustard seed with berseem to increase the quantity of fodder from first cutting.



Method of sowing: The seed should be broadcasted in the standing water when weather is calm, in case of high wind the seed should be broad casted evenly in dry land followed immediately by planking and irrigation. The seed should be free from seeds of Chickory (*kasni*) and other weeds. To ensure this, put berseem seeds in 5% salt solution and sieve off or decant off the floating weed seeds. Stirring the standing water is essential to cover the seed with a fine layer of soil for hastening germination.

Among leguminous crops, berseem has its conspicuous importance of fodder. Farmers mostly do not fertilize this crop. Berseem shelters specific nitrogen fixing bacteria '*Rhizobium trifoli*' in its root nodules and if the same are inoculated artificially will pronounce the crop yield. Therefore, inoculation of berseem with *Rhizobium* culture is very essential.

Weed control: For effective control of *Poa annua* apply fluchloralin @ 0.4kg/ha in 200 lit of water just before sowing. For control of *itsit* (*Trianthema portulacastrum*), berseem should be sown as mixed crop with raya.

Manure and fertilizers: FYM if not applied to *Khariif* crop, apply FYM @10 tonnes/acre about one week before sowing during preparatory tillage. Apply fertilizer @ 20 kg of P_2O_5 / acre and 12 kg of N/ acre at the time of sowing and 12 kg N as top dressing after first cut.

Irrigation: First irrigation is important and should be applied early to maintain good stand. On light soil, irrigation may be given within 3-5 days after sowing whereas, on heavy soils it may be delayed for 8-10 days. Afterwards irrigations are given at intervals of 15-20 days depending upon weather conditions. Irrigate the crop after each cutting.

Harvesting: 1st cut is ready after 45 days of sowing and subsequent cuttings after 25-40 days of sowing depending upon weather conditions. For seed production suspend harvesting of green fodder in middle of March. It gives 80-100 kg seed/acre if crop is kept for seed production.

Berseem should be given to animals mixed with some roughage/ wheat straw etc. Exclusive feeding of berseem can cause bloat in animals. When berseem is fed in appreciable quantity, reduce concentrate feeding proportionately.

Plant protection:**Disease management**

Disease and symptoms	Management practices
<p>Stem rot (<i>Sclerotinia sclerotiorum</i>): Minute mycelial growth in patches result in soft rot, wilting and death of tillers/crown of berseem hills. The disease occurs during winter months (Dec.-Feb.) causing considerable losses in infected fields and has wide host range.</p>	<ol style="list-style-type: none"> 1. Avoid regular sowing of berseem in same field and follow crop rotation. 2. Deep ploughing and flooding during summer. 3. Seeds must be free from black sclerotial bodies of fungus. 4. Treat the seed with carbendazim @ 2g/kg of seed, spray carbendazim + mancozeb @ 0.25%.

Oats

Oats (*Avena sativa*) is an important *rabi* fodder crop grown under restricted irrigation facilities. Nutritive value of oat is next to leguminous forage crops.

Climatic requirement: Oat makes best growth in cool, moist climate. High temperature at flowering stage increases proportion of empty spikelets and reduces the seed yield.

Varieties:

1. Kent: It is resistant to rust, blight diseases and lodging. It is medium late and erect type with long droopy leaves. Average plant height at 50 percent flowering is 75-80cm. Its potential green fodder yield is about 200q/acre.
2. HFO-114: This is an early sown variety which provides two cuts and has good tillering, synchronous flowering. The variety is tall, bold seeds and resistant to lodging and diseases. It produces 200-220q/acre of green fodder in two cuts and 8q/acre of seed.
3. Sabzar: The variety has profuse tillering, leafy and suitable for dual purpose. It is recommended for temperate and high altitude regions of Jammu. It produces 140-160q/acre of green fodder.
4. Palampur-1: It is characterized by medium maturity, profuse tillering and resistant to lodging. It produces 200q/acre of green fodder.

Agronomic Practices

Land preparation: Oat can be grown on all soil types except water logged and extensively saline soils. But it does well on loam and clay loam soils. Soil should be prepared by deep ploughing followed by 2-3 harrowing and planking.

Seed rate: 40 kg/acre

Sowing time: Mid-October to 1st week of November is most suitable time for sowing.

Method of sowing: Line sowing is the best method. Keep the lines 20-25 cm apart.



Manure and Fertilizers: 6-8 tonnes of FYM/acre may be applied one week before sowing. Apply 16 kg N and 16 kg P₂O₅/ha and 8 kg K₂O at the time of sowing and 16 kg N/ acre after taking the 1st cut of fodder i.e. 60-70 days after sowing.

Sowing with Zero tillage: Oats can also be sown for seed and green fodder production without seed bed preparation with zero till drill after harvesting of *Khariif* crop (rice). In weed infested fields, weed can be controlled by spraying appropriate weedicide. Zero tillage has many benefits viz. saving of time and diesel, reduction of environment pollution, saving of labour and irrigation water in first irrigation thus resulting in high monetary benefits. Crop can be sown timely after taking basmati.

Harvesting: 1st cut after 60 to 70 days of sowing and second cut at 50% flowering stage may be taken. For first cut harvest at a height 5 cm above ground level for better regeneration.



Lucerne (Alfa alfa)

Lucerne (*Medicago sativa*) is most nutritious fodder legume rich in proteins, calcium and phosphorus. It is perennial and provides fodder round the year, yield decreases slightly during rainy season. The herbage can be made available during the lean periods of fodder supply i.e. September -December, and then again in May-August. Its hay can largely replace costly concentrates. It grows well in soil pH range of 6.5 to 7.2.

Agronomic Practices

Land Preparation: A weed free fine seedbed is to be prepared by repeated tillage operations. Good drainage is also essential

Sowing: Time of sowing is 1st fortnight of October.

Seed rate: 6-8kg/acre

Method of sowing: Broadcast the seed in standing water after making plots of convenient size so as to facilitate irrigation.

Inoculation: Use *Rhizobium* culture for treating the seed.

Manure and Fertilizers: For one acre, apply 10 tonnes of FYM, 30 kg P₂O₅ and 8 kg N. Apply entire FYM 3-4 weeks before sowing. Entire dose of P₂O₅ and 50% N is to be applied along with the last preparatory tillage operation and 50% of N is given in split doses.

Irrigation: 15-16 irrigations are needed round the year.

Harvesting: 7-8 cuttings are possible.

Yield: 200-240 q/acre.

Note: Lucerne should be supplemented by a grass fodder. Such a mixture will not cause bloat, which is due to certain leucocides known as saponin.

Fodder Rape

Rape (*Brassica rapa*) can grow at a fast rate even under limited moisture availability. So it is an important fodder crop in the semi-arid and sub-humid parts and as well as in temperate conditions of the UT. The crop provides green fodder during the scarcity period of November-December because of quick growing habit.

Agronomic Practices

Land Preparation: Requires fine seed bed for good germination.

Soil: Medium loam soil is the best for this crop.

Seed rate: 2.4-2.8 kg/acre

Time of sowing: First fortnight of October is best sowing time.

Fertilizer application:

Rain fed conditions	Nutrient (kg/acre)			Fertilizers (kg/acre)		
	N	P ₂ O ₅	K ₂ O	Urea	DAP	MOP
	16	8	4	28	18	7

Apply fertilizer at depth of 5-7 cm below seed at time of sowing.

Irrigation: 2-3 irrigations depending upon the weather conditions.

Harvesting: Harvest 50-60 days after sowing for fodder. For seed purpose, harvest the crop when pods turn straw color in order to avoid losses due to shattering

Yield: Green fodder 80-120 q/acre. The seed yield is about 280-320 kg/acre when sown exclusively for seed purpose.

Table: Nutritive value of Fodder

Fodder	Crude protein on dry matter basis (%)	Total digestible nutrients on dry matter basis (%)
Berseem	18	60.5
Lucerne	21	58.5
Senji	18	62.0
Oats	9.5	64.0

Kala Zeera

Kala zeera (*Bunium persicum*) (Boiss.) Fedtr., an aromatic and medicinal perennial herb belongs to family Apiaceae. The plant is a native of Europe & Western Asia, but is now widely distributed in dry temperate regions of both hemispheres. It grows as a wild plant at an elevation between 1850-3100 amsl. It is one of the important traditional crops in the backward areas of Gurez, Kargil & Padder in Jammu and Kashmir. The seeds are harvested only during June-July from the wild population from the forests or grazing lands by the migratory people of these areas.

The plant has been used in the Indian System of Medicine since time immemorial. The seeds are regarded as stimulants & carminative and useful in curing of diarrhea, dyspepsia, fever, flatulence, stomachache, hemorrhoids, amnesia, boils & obstinate hiccups. Seeds, a rich source of thymol are used against hookworm infection and also as antiseptic in many proprietary preparations. The straw left after harvesting of seed is also a rich source of volatile oil (1.25%) & oleoresin. Besides, these it is also considered as one of the important condiment commonly used to add fragrance & taste in dishes, bakery & culinary items.

Soil and Climate

It prefers well drained sandy loam soils, rich in well decomposed organic matter. Light to moderate showers in the growing season i.e. (April-May), bright sunshine, a severe winter with snow up to 1-5 meters & heavy dew is a blessing for the crop. Snowfall after sprouting and even frost is injurious to the crop. But seed and tubers require long chilling periods for better crop. However, crop ready for harvest if marred by a cloudy weather or rains, affect yield, flavor and seed quality.

Agronomic Practices

Land Preparation

The field should be thoroughly ploughed 3-4 times before sowing & planked. Full doses of FYM, DAP, MoP & 1/4th of Urea should be applied before the final ploughing. The balance urea should be splitted into 3 equal doses and applied as top dressing, during intercultural & weeding operations at sprouting, bolting & flowering, respectively. Since the crop is perennial, therefore, in the subsequent years only one light ploughing during October-November with the same recommended dose is sufficient to harvest good crop.

Seed rate: Seeding @ 1-1.5 Kg/ha at first sowing & re-seeding @ 200g/ha seed in subsequent years, help in maintenance of optimum plant population (1.5-2.0 lac/ha). About 1.67 lac tubers are required to plant one hectare area at a spacing of 30cm x20cm.



Method of Sowing: Seeds of Kala zeera are small & therefore be sown by mixing with sand. Seeds should be placed 4-5 cm deep in 10 cm deep open furrows, lined 50-60 cm apart. The crop can also be grown as an intercrop with rajmash, beans, peas, minor millets or saffron in the fields or on sloppy areas as an understorey crop in the orchards of apple, apricot and almond. Before sowing seed should be treated with fungicides copper oxychloride @3g/kg of seed.

Propagation: Kala zeera is propagated through seed which is sown in October-November and takes 4 years to produce seed crop. Each seed produces one tuber and tuber does not multiply vegetatively. Tubers too can be used for raising the crop which produce crop in the same year. Same tubers continue to give crop for 8-9 years.

Manures & Fertilizers: The crop is raised traditionally without the application of organic manures, chemical fertilizers and adoption of best agro-techniques. The following doses of manures & fertilizers/acre should be used to get optimum yield.

- | | |
|---------|-------------|
| 1. FYM | 4-6 t/acre |
| 2. Urea | 42 kg/ acre |
| 3. DAP | 28 kg/ acre |
| 4. MoP | 20 kg/ acre |

Weed management: The crop must remain weed free. 3-4 weedings at the interval of 20-25 days are sufficient. Use of pre-emergent weedicide like pendimethiline @ 0.4 kg a.i. per acre can be effective to control weeds.

Irrigation: 2-3 irrigations if available are sufficient to meet the water requirement of the crop.

Plant Protection

Following control measures are recommended against insect pest and diseases which cause severe damage to the crop.

I. Insect-Pest and their Management

The tubers are attacked by white grubs & above ground foliage by hairy caterpillars, army worms and semi loppers. White grubs can be controlled by mixing cartap hydrochloride 4G @ 8kg/acre in soil during last ploughing. For others, spray the crop with dimethoate 30 EC @ 1.5-2 ml/litre of water or oxydemeton methyl 25 EC @ 1ml/litre of water or chlorpyrifos 20EC @ 2ml/litre of water.



II. Diseases and their Management

Blight: It can be controlled by spraying carbendazim + mancozeb @ 0.25 % or copper oxychloride @ 0.3% at a fortnightly interval from first appearance of the disease.

Harvesting & Storage: The crop raised through seed takes about 4 years for the production of seeds. Normally crop matures in last week of June or early July. The crop should be harvested when the seeds turn brown. Over mature crop is prone to shattering and harvesting is done daily in the morning & stacked in a dry store. The total harvesting period lasts for 10-12 days. The stacked plants should be dried in sun for 2-3 days & seeds are separated by beating with sticks at a protected place. Grains are separated after winnowing and stored in air tight containers.

Yield & Economics: Crop yields vary from year to year and on an average from a well-established crop about 1.5-2.0 q/ha of kala zeera seed can be produced. The yield levels can still increase provided adequate plant population is maintained. As far as economics is concerned, a farmer growing kala zeera under scientific management can earn 30-40 thousands rupees annually per hectare. Market price is variable and ranges between Rs. 1500-1800/kg.

Poplar Farming

Agroforestry is a remunerative farming system where fast growing trees are grown with agricultural crops. Poplars can be grown with field crops in fruit orchards, farms and link roads, cattle sheds and homesteads. They are greatly valued for their multiple utility and growth rate. Wood is being used in paper & pulp, match splints, sports goods, toy and pencil making, packaging and plywood industries. For better returns from poplar cultivation the following production recommendations may be followed.

Climatic and soil requirements: Poplar grows well in the sub-tropical climate where temperature extremes are not too severe. Optimum Poplar growth can be realized on deep, loose, porous, well drained and fertile loam/sandy loam soils with pH ranging from 5.5 to 7.5.

Choice of Clones: The choice of particular Poplar cultivar is very important and is a continuous process. A particular poplar clone suitable should not be planted unless it has been adequately tested in a local area or a region. There are many clones available, but on the basis of field evaluation G3, G48, S7 C15, Udai, WSL-22 and WSL-32 clones are performing better under the sub-tropical conditions of Jammu division.



Nursery Techniques: Poplars are planted through rooted stem cuttings which can be raised in the nursery. The soil should be ploughed deep and clods, stubbles, root stumps etc. should be removed. The sunken nursery beds should be prepared of suitable size depending on area and water supply. Farmyard manure (FYM) @ 20 tonnes/ha should be added to soil. Nitrogenous fertilizers @ 50-60 kg/ha (200-240kg CAN/ha) has been observed better for rooting of cuttings. It should be applied in split doses i.e. one half after sprouting of cuttings and other half in the month of July.

Cuttings should be prepared during middle January to middle February. The size of the cutting should be 20-30 cm with diameter ranging from 10-20 mm. Cutting should be free of space insect damage, mechanical injuries and should have atleast 3-4 healthy buds. They should preferably be taken from leading shoot or from the stool bed nursery. The diseased, dying and suppressed plants should not be used for preparation of cuttings. The cuttings should be treated with 0.5% emulsion of Aldrex for 10 minutes against the termite attack. Cuttings should be planted in the nursery beds at a spacing of 80x60 cm. The survival of cuttings may increase if soaked in fresh water for 3-4 days before planting. The entire length of cuttings should be inserted into the soil with buds pointing up and keeping one bud above the soil surface or with not more than 5 cm portion exposed. A hole greater than the size of cuttings should be made in the soil by using a bamboo or iron peg. After planting of cutting, soil around the cuttings must be pressed gently and irrigation should be given immediately. Subsequent irrigations should be given after 8-10 days & repeated depending upon the requirement. The best time of planting Poplar cuttings is January-February. To reduce competition, regular weeding in the nursery is necessary. Only one shoot should be allowed to grow and other off shoots should be pruned.

Planting Out: Nursery raised one year plants called Entire transplants (ETPs) about 2-3 m in length should be dug out from the soil. The main root is kept about 25 cm in length and others should be cut at length of 10-15 cm. The normal pit size for planting is 45x45x100 cm (l x b x d). The January and February are the best months for transplanting Poplar from nursery to the field. Before planting out pits should preferably be dug out at a spacing of 5x4m. Each pit should be filled with 5 kg of well rotten farm yard manure, 5 litre solution of chlorpyrifos (0.1%) per pit should also be applied for soil drenching against termites. Lower portion of ETPs upto 1m should be dipped in 0.3% solution of copper oxychloride for one hour before planting.

Irrigation: Irrigation should be applied immediately after planting and later on 15-20 days interval. However, it depends on the requirement of plants during normal as well as during dry period.



Fertilizer requirement: Fertilizer dose depends upon the soil fertility and age of the tree. In the 1st year, 100g SSP, 25g MOP and 20g Zinc sulphate per plant should be applied. When Poplars are grown with agricultural crops there is no need of applying fertilizer separately for poplars.

Weed management: Weeds tend to draw the nutrients meant for trees and crops thereby affecting the productivity of both. They also compete for soil moisture. Weed should be kept under check through regular weeding and hoeing operations manually.

Intercropping

Intercropping with poplars is a bonus in addition to the better performance of the tree growth as the intercultural operations done to the intercrop also benefits the trees. Almost all the *rabi* and *kharif* crops can be grown during the first 03 years except paddy. However, Poplar being deciduous tree, *rabi* crops like wheat, oats, barseem, sarsoon, vegetable etc. can be grown successfully throughout the tree rotation. Turmeric, ginger and some other medicinal/aromatic plants such as *Raufofia serpentina*, *Aloe barbadensis* etc. can also be raised in association with poplar trees.

After care: All buds which sprout on lower than 3m of stem should be removed during first year of growth of Poplars. During second and third year any branch competing with the leader branch and other interfering branches should be cut close to stem during the month of January when tree is leafless.

Following pruning schedule should be followed:

Tree age (Years)	Pruning intensity
1	No pruning, only debudding
2-3	Lower 1/3 of the trees height is cleared of branches.
4-5	Upto ½ of the total free height is cleared of branches
After 5	Upto 2/3 of total tree height is cleared

Pruning should be done during winter season only and immediately after pruning the cut ends should be pasted with Bordeaux paste. Excessive pruning is harmful and should normally be avoided.

Plant Protection

I. Insect-pest and their Management

1. Mites: These become active during summer months. They cause reduction in leaf size and treatment with dimethoate 30 EC @ 1.5-2 ml/litre or propargite 57 EC @ 1.5-2 ml/litre in young plants is helpful.



2. **Stem borer:** Clean the borer hole by inserting a wire and push the cotton wick soaked in Petrol or inject the solution of malathion 50 EC or profenofos 50 EC @ 2ml/litre of water.
3. **Defoliators:** Spray with malathion50 EC @ 2ml/litre of water or acetamiprid 20 SP @ 0.2 ml/litre of water.
4. **Galls:** During April when gall formation is initiated, spray the plants with metasystox 25EC @ 1ml/litre of water or dimethoate 30EC @ 2ml/litre of water or in serious condition spray imidacloprid 17.8 SL @ 0.3 ml/litre of water

II. Diseases and their Management

1. **Rusts:** Spray 3 times at 10 days interval with 0.3% Cosan.
2. **Root Rot:** To control this disease the infested tree should be treated with 0.3% copper oxychloride or 0.1 to 0.2 % carbendazim (25 litres water per tree).

Harvesting: Poplar plants are ready for harvest at an age of 6-8 years when they attain a girth of 100cm at 1.37m height from ground level.

Marketing: Marketing is done either as standing trees or after felling and cutting into logs of desired length. The trees with good form, clean, straight and cylindrical bole fetch higher price. The poplar wood is generally purchased by the saw millers at an average rate of Rs. 400-500/q, a tree of 100 cm girth produces about 7-8q of wood.

Mushroom

A. Button Mushroom

Agaricus bisporus, the white button mushroom is one of the most popular mushrooms in the world and contributes more than 80 percent of Indian mushroom production. White button mushroom is basically a cool season mushroom and requires a uniform temperature of 16-18°C for fruiting.

Compost preparation

White button mushroom is cultivated on the specially prepared selective substrate known as compost. The compost for growing white button mushroom can be prepared by either Long method of composting or Short method of composting. Long method of composting is a conventional method and generally adopted by the seasonal mushroom growers where facilities for bulk pasteurization are not available. This method is designed to carry out the complete composting process in outdoors by achieving pasteurization under natural weather conditions. The formula recommended by SKUAST-J is:

Material	Quantity (Kg)
Wheat straw	500
Chicken manure	200
Rice bran	50
Mustard oil cake	25
Urea	04
Gypsum	25

Compost by this method is prepared on a clean cemented platform. Before initiating the composting process, the area selected for composting should be cleaned and disinfected by spraying formalin @ 2%. The wheat straw is spread uniformly and water is sprinkled over the straw with the pipe line and frequently turned till it absorbs sufficient moisture. Wetting of the straw may continue upto 24-48 hours till it absorbs around 75% moisture. When the straw becomes fully wet, it is collected as a low heap on one side of the yard. All other ingredients except gypsum are thoroughly mixed with wet straw and low heap with 2.5 - 3 feet height is prepared. On sixth day, the pile is break opened and turned into another pile. Breaking of compost pile and turning facilitates homogenization, provide aeration and remove ammonia generated in the composting process. During reconstruction of the pile, water is added whenever required. On tenth day, second turning is given as similar to first turning. On thirteenth day, required amount of gypsum is added and third turning is given. Similarly 4th, 5th, 6th and 7th turnings are made on 16th 19th, 22nd and 25th day, respectively. On 28th day, the ammonia content in the compost is to be

checked. If the smell of ammonia persists, the compost may be turned upright down so that the smell of ammonia escapes. The compost with pleasant smell and absence of ammonia indicates its readiness for spawning. Good quality compost is dark brown in colour and not greasy or sticky, have distinct sweet inoffensive smell, free from smell of ammonia and have optimum moisture.

Spawning

Once the compost is ready, it is thoroughly mixed with the completely colonised fresh spawn. The spawning activity should be done on the clean and disinfected area. The optimum dose of spawn is at the rate of 0.5-0.75 percent of compost on fresh weight basis. Spawn can be added in layers in the compost bags or may be added thoroughly in the compost before putting in the bags.

Crop management

For spawn run, air temperature of $23\pm 1^{\circ}\text{C}$ and RH of 85-90% is maintained in the room. After 18-20 days, when the spawn run gets completed, a 1.5-2 inches layer of casing soil consisting of a mixture of 2 years old FYM and garden soil in 1:1 is applied on the top of spawn run bags. Casing soil should be treated with formalin before application. After application of casing, light watering is needed on the top layer of bags. 85% crop will appear within a week in the form of pinheads which mature to fruits bodies of 3-4 cm diameter within 4-5 days. The crop appears in 5-6 flushes of 3-4 days duration each with a gap of 3-4 days. The uniform fruit bodies of 4-5 cm in diameter are handpicked in a twisting motion. Harvested mushrooms should be wiped with a wet cloth and packed in perforated poly bags. Efforts should be made to sell the mushrooms as soon as possible or they may be processed into value added products to fetch a better price.

B. Oyster Mushroom

Pleurotus species popularly known as oyster or *dhingri* mushroom is emerging as an important mushroom variety because of its wider adaptability to different climate and substrates and easy cultivation technique. Oyster mushrooms are a good choice for beginners in mushroom cultivation. The productivity is very high as compared to all other cultivated mushrooms. Oyster mushroom can be cultivated on a wide range of agro-wastes such as cereal straw, sugarcane bagasse, dehulled corncobs etc. The substrate should be fresh, dry, free from mould infestation and properly stored. The substrate (wheat straw) after chopping (5-10cm) is soaked in hot water (65 to 70°C) for one hour or in case of paddy straw at 85°C for 30-45 minutes. After draining excess water, spawn is added. Spawn is mixed @ 2-3% of the substrate on wet weight basis. The spawning should be done under clean and hygienic conditions. Spawning can be done either by layer or thorough spawning. The spawned

substrate is filled in poly bags (60 × 45 cm) of 125-150 gauge thickness. 10- 15 small holes (0.5-1.0 cm dia) should be made on all the sides especially two to four holes in bottom to leach out excess water. These bags are closed airtight and are kept in growing room for spawn run process. The bags can be kept on a raised platform or shelves or can be hanged for mycelial colonization of the substrate. Although mycelium can grow between 10-30°C but the optimum temperature ranges between 22-26°C. Higher temperature more than 30°C in the cropping room will inhibit the growth and might kill the mycelium. During mycelial growth, the bags are not to be opened and do not require much ventilation. Spawn run completion requires minimum of 12-15 days depending upon the incubation temperature, substrate used and mushroom variety. High relative humidity (70-80%) is required during fruiting. To maintain relative humidity, water spraying is to be done in the cropping rooms. During hot and dry weather conditions, spraying has to be done 2-3 times while in hot and humid conditions (monsoon) light spraying is sufficient. The judgement of spraying can be made by touching the surface of the substrate. Spraying should be done with a fine nozzle to create a mist or fog in the cropping room. Ventilators and exhausts fans should be operated for air circulation so that the excess moisture from the pileus surface evaporates.

Sufficient aeration is needed to provide and maintain the carbon dioxide concentration at an optimum level of 600 ppm or lesser during fruiting period. Higher CO₂ concentration results in elongation of stipe and small pileus resembling trumpet mouth shaped mushrooms. Light is required to initiate fruit body initiation. Inadequate light conditions can be judged by long stalk (stipe), small cap and poor yield. With suitable crop management practices, mushroom fruit bodies are ready for harvesting in 6-8 days after pinheads formation. Mushrooms should always be harvested before spraying water. The right stage for picking can be judged by the shape and size of fruit body. Mushrooms should be picked while the edges of the caps are still curled down. If the mushrooms are allowed to grow bigger, it results in poor quality mushrooms. It is advisable to harvest all the mushrooms at one time from a bag so that the next crop of mushrooms starts early. The best quality of mushrooms can be harvested from the first and second flushes due to the availability of sufficient nutrients. Under normal room temperature conditions, fresh mushrooms can be stored for 2-3 days without any deterioration. Unlike white button mushroom, the oyster mushroom fruit bodies can be easily dried and stored. The fruit bodies can be dried under sunlight to the moisture level of 8-10 %. The dried oyster mushroom with 2-4% moisture can be stored for 3 to 4 months without losing its original properties after proper sealing. Dried oyster mushrooms can be instantly used after soaking in hot water for 5 to 10 minutes or it can be used in powdered form for several preparations.

Apiculture

There is vast potential for beekeeping in the Union Territory of Jammu and Kashmir. However, due to lack of knowledge scientific beekeeping is not being practiced by the beekeepers. It is necessary for beekeepers to participate in the trainings/other capacity building programmes on the subject to gain scientific knowledge on the subject. Selection of good apiary site, good quality bees and proper management are the main keys for success of beekeeping. Always use recommended methods to control swarming, division of colonies, uniting of colonies, mass queen rearing, stopping laying workers, robbing, desertion, migration and maintenance of diseases, pests and enemies etc. The following practices should be followed for effective and beneficial beekeeping.

Selection of good apiary site

- Select apiary site by considering the following:
- Apiary ground should be clean & free from dry leaves etc. to avoid fire during summer.
- Apiary site should be away from power station, brick kilns, highway and train tracks.
- Site should be open & at a dry place having shade and easily accessible by road.
- Fresh running water should be easily available near the apiary and have natural/artificial wind breaks.
- Site should receive early morning and afternoon sunshine.
- Area should be rich in bee flora.
- There should not be any source of stagnant/dirty water, chemical industry/sugar mill etc. nearby the apiary.

Selection of good quality bees

Beekeeping can be done by domesticating two species of honey bees viz: *Apis cerena* and *Apis mellifera* depending upon floral conditions and capability of investments. However, success in both cases depends on the quality of bees, particularly the queen. Therefore, the following should be kept in mind to select the bee colonies:

- 1) Buy disease-free bee colonies from existing beekeepers after getting training on the subject.
- 2) Select and multiply honey bee colonies only from disease-resistant, high honey-yielding, young, healthy and high egg-laying capacity queen. Etc.
- 3) Keep colonies with good prolific queens.
- 4) Capture few bee colonies from their natural abodes in forests which may be used for further breeding/multiplication to prevent inbreeding.

Maintenance of apiary

Placement of colonies apiary

- i. Hives should be as per specification of BIS/ISI and should be of locally available seasoned light weight wood. Unseasoned and heavy wood should be avoided
- ii. Avoid nailing the bottom board with the brood chamber.
- iii. Restrict number of bee colonies in a apiary from 50-100.
- iv. Keep row to row and box to box distance as 10 and 3 feet respectively.
- v. Avoid over-stocking of colonies in the apiary.

Inspection of colonies

- i. Adopt general colony and personal hygiene in the apiary like cleanliness in the beehives including cleaning the bottom board top cover etc. frequently.
- ii. Check the colonies periodically for any abnormalities or change in behavior of bees.
- iii. Inspect colonies on clear sunny days preferably at temperatures between 20 and 30C
- iv. Do not inspect colonies in cold windy and cloudy days.
- v. Use smoker when needed to subdue the bees.
- vi. Use protective dress and veil while inspecting colonies.
- vii. Handle colonies gently avoid jerks.
- viii. Avoid crushing bees as it could lead to stinging.
- ix. Isolate the diseased colonies from healthy ones.
- x. Handle diseased and healthy colonies separately.

C. Provision of fresh water in the apiary

- i. Ensure availability of fresh water preferably in shallow containers near the apiary to maintain a healthy apiary. Water is needed for the following
- ii. Maintenance of adequate humidity in a colony to ensure proper incubation of eggs.
- iii. For feeding bee bread by nurse bees the mixture of honey and pollen of certain consistency is required for which water is needed.
- iv. When temperature in the apiary increases beyond 37C water is used by bees to evaporate and cool the colony.

D. Dearth period management

- i. Provide 50% sugar syrup to the colonies during dearth periods when honey stores in the colonies is not adequate and nectar is not available in the area. The syrup should be prepared by boiling clean water in the vessel and sugar added with slow stirring for few minutes. Cover the vessel with lid and let it cool. Feed cooled syrup.
- ii. Feed the colonies in the evening preferably after sunset.



- iii. Pollen substitute comprising of fat free soyabean flour (3 parts) + Brewer's yeast (1 part) + Skim milk powder (1 part) + sugar (22 parts) + honey (50 parts) made in the form of patties should be provided when pollen stores in the colonies is not adequate and pollen is not available in the area.
- iv. Extra frames should be stored in air tight chambers and fumigated with sulphur powder regularly.
- v. Old and dark combs should be discarded.

E. Care during honey extraction

- i. Use honey extractor, containers and other bee hive tools/equipments made of stainless steel/food grade plastic. Don't use tins & containers made of other degraded material.
- ii. Wash all the equipments/containers etc. thoroughly with warm water before honey extraction.
- iii. Extract honey from super chambers only.
- iv. Select frames only with 75% sealed cells with ripened honey for extraction.
- v. Cover the entrance gate of the colony with small branches or twigs to avoid robbing.
- vi. Extract honey in a closed room and not in the open to avoid robbing.
- vii. Do not leave super and brood frames after extraction of honey open in the apiary:

F. Care during migration

- viii. Migrate colonies during non-availability of flora to areas with abundant flora.
- ix. Before migration survey the area to assess the availability of the flora to locate the colonies
- x. Ensure honey extraction before migration.
- xi. Close the entrance gates of the colonies in the evening after all the worker bees are inside the colony
- xii. Pack the colonies internally and externally before migration to avoid jerking.
- xiii. Colonies in the vehicle should be packed in such a way that the entrance side should face the front side of the vehicle.
- xiv. Start migration late in the evening and ensure the colonies reach the destination within 10-12 hours, the next day morning and entrance gates are opened after landing in the new location.
- xv. If the destination is far away keep colonies by halting at an appropriate place in day time and open the entrance gate and repeat the process of migration.
- xvi. Avoid jerking in the way while transporting bee colonies.

Floral map for migratory beekeeping

Migration site	Period	Major bee flora
Higher hills (whole of Kashmir and higher reaches of Doda, Ramban, Banihal, Kishtwar Poonch and Rajouri districts)	February - April	<i>Brassica sp., Trifolium sp., Robinia pseudoacacia, Prunus, Rosa, Acacia, Rubus</i>
	May - June	<i>Acacia, Brassica, Raphanus, Fagopyrum, Acacia sp.</i>
	July - August	<i>Zea, Trifolium, Indigofera, Helianthus, Plectranthus</i>
	September - October	<i>Zea, Trifolium, Helianthus</i>
	November - December	<i>Crocus</i>
Lower hills (parts of Doda, Ramban, Banihal, Kishtwar Udampur, Poonch and Rajouri districts)	January - February	<i>Salvia, Salix, Viburnum, Rosa</i>
	October - March	<i>Isodon rugosus, Brassica campestris, Wendlandia, Toon</i>
	October - December	<i>Brassica campestris var. toria, Eucalyptus</i>
	November - May	Litchi, berseem, sunflower
	April - June	<i>Litchi, Citrus, Prunus, Acacia, cucurbits, Adhatoda vasica, Pyrus, Rosa, Rubus sp.</i>
	July - August	<i>Trifolium, Medicago, Plectranthus, Dianthus</i>

	August - October	<i>Zizyphus, Maize, Brassica, Trifolium, Olea sp.</i>
	February- March	<i>Brassica sp., Eucalyptus, shisham, drumstick</i>
	December- March	<i>Brassica sp., Eucalyptus, coriander, Fennel,</i>
	March-May	<i>Jamun, Indigofera, Allium</i>
Plains (Jammu, Samba parts of Kathua and Udhampur))	January - March	<i>Brassica, Mangifera, Wendlandia</i>
	March - April	<i>Brassica, Cassia, Citrus, Dalbergia, Mangifera,</i>
	May - June	<i>Dalbergia, Zizyphus, Cassia, Acacia, Grewia</i>
	July - August	<i>Acacia, Zizyphus, Grewia</i>
	September - October	<i>Sesamum, Zea, Acacia, Zizyphus</i>
	November - December	<i>Brassica, Bauhinia</i>

MIGRATION ROUTES

Area of migration	Period
OUTSIDE THE UNION TERRITORY	
Banihal, Ramban	June - Ending October
Jammu	Ending October-November
Aligarh	Ending October - End of December
Rajasthan (Alwar, Kota, Ganga Nagar)	Ending November / December-Mid February

Rajasthan (Ganga Nagar)	Ending November - Mid March
U.P. (Saharanpur)	Mid February - Mid March
Bara (Kota; Rajasthan)	Mid February - Mid March
Jammu (Purmandal, Bishnah, Miran Sahib, R. S. Pura, Ghou Manhasan)	Mid March - Ending May
Jammu (higher reaches of Reasi, Samba, Udhampur, Rajouri)	June - July
Srinagar, Anantnag	March – July
WITH IN THE UNION TERRITORY	
Jammu (R. S. Pura, Bishnah, Purmandal), Samba (Mansar, Raya Morh, Dhiansar), Kathua (Chadwal, Billawar, Dayalachak) and Udhampur (Chenani)	December – March
Upper reaches of Jammu, Samba, Kathua, Rajouri, Poonch and Udhampur	April – June
Doda, Banihal and Ramban districts	June-August
Upper reaches of Sunderbani (Rajouri) and Nowshera (Poonch) areas	April – July
Srinagar, Anantnag, Quazigund, Pulwama, Pampore	May-June

G. Seasonal Maintenance of apiary

a) Summer Maintenance

- i. Keep the colonies in thick shade
- ii. Regulate the microclimate of the apiary by using wet gunny bags over top cover and sprinkling water around the colonies in the apiary during noon hours.
- iii. Provide proper ventilation in the colony by widening the entrance gate of the colony providing additional gate to multi chambered colonies placing thin small stick pieces between two adjacent chambers for the passage of fresh air reducing the number of frames by 1 and allow 9 in the chamber.
- iv. Provide fresh water in/near the apiary.

b) Monsoon Maintenance

- i. Clean and bury deep the debris lying on the bottom board
- ii. Keep the surroundings of the colony clean by cutting the unwanted vegetation which may hamper free circulation of the air.
- iii. Provide artificial feeding (Sugar syrup and/or pollen substitute) as per requirement of the colony.
- iv. Check the robbing within the apiary.
- v. Unite weak/laying worker colonies.
- vi. Control predatory wasps ants frogs lizards in the apiary.

c) Post monsoon season management

- i. Provide sufficient space in the colony
- ii. Strengthen the colonies to stimulate drone brood rearing.
- iii. Control ectoparasitic mites wax moth and predatory wasps.
- iv. Extract autumn honey before the winter sets in

d) Winter management

- i. Examine the colonies and provide winter packings in weak colonies specially in hilly areas.
- ii. Feed sugar/ pollen substitute to weak colonies as stimulative feeding to provide energy and initiate brood rearing.
- iii. Shift the colonies to sunny places.
- iv. Protect the colonies from chilly winds by using wind breaks.
- v. Unite the weak colonies with stronger ones.

e) Spring Maintenance

- i. Unpack the colonies clean the bottom board replace the worn out hive parts and provide sufficient space.
- ii. Provide stimulative sugar/pollen substitute to increase brood rearing.
- iii. Equalise the colonies.
- iv. Extra frames should be raised by providing comb foundation sheets.
- v. Replace the old queens with new ones through mass queen rearing or divide the colonies.
- vi. Manage the colonies in such a way to prevent swarming.
- vii. Monitor regularly for ectoparasitic mites and adopt control measures.
- viii. Extract honey frequently during this season.

H. Protecting colonies from pesticides

- i. Persuade the farmers not to use selective pesticides that are less harmful to bees at recommend concentrations

- ii. Avoid the use of dust formulations as they are more harmful to bees than spray formulations.
- iii. Prior information about spraying would help in reducing poisoning of bees.
- iv. Avoiding spraying of pesticides during flowering of the crop and peak foraging time of the bees would help in reduction in the mortality of foraging bees.
- v. Spraying may be done in the evening after sun set when bees do not forage.
- vi. Colonies may be temporarily shifted if heavy spraying schedule is fixed.
- vii. If shifting of the colonies is not possible feed with 200 ml sugar syrup and close the gate by using wire screen for the day of spraying.

I. Maintenance of Honey Bee Diseases and enemies

Honey bees could be affected by diseases and the real cause of abnormality or any disease present in the honey bee broods need to be ascertained before taking up any control measures. It is best to contact the researchers/scientists/beekeeping experts at the nearest centre or university or Government department working on honeybees. After the exact diagnosis of the causal agent of the particular disease the guidelines/recommendations given by the expert should be followed in true letter and spirit. However general advisory for the Maintenance of common diseases of honey bees is given below:

- a. Select good site to locate the apiary preferably in an open dry place with shade.
- b. Adopt general colony hygiene in the apiary like cleanliness in the beehives including cleaning the bottom board frequently.
- c. Select and multiply honey bee colonies only from disease resistant stocks.
- d. Keep colonies with good prolific queens.
- e. Create bloodlessness in colony for at least 15 days by enclosing the queen in a queen cage.
- f. Check the colonies periodically for any abnormalities or changes in behavior of bees.
- g. If you observe any colonies with disease isolate them from healthy ones. Handle diseased and healthy colonies separately.
- h. Keep the colonies strong by adding sealed brood comb or worker population only from healthy colonies and also by providing adequate food during dearth periods.
- i. Prevent robbing drifting absconding and avoid migration of bee colonies when you notice disease symptoms.

- j. Follow Shook Swarm or shaking method to remove contaminated combs completely by transferring entirely new combs in one operation to the colonies with diseases symptoms. Destroy the removed combs by burning.
- k. Sterilize the combs and equipments by any one of the following methods:
 - 1) Disinfect the empty combs and equipments with 80 per cent acetic acid @ 150 ml per hive body in piles for few days at a protected place. Air the treated materials before use.
 - 2) Dip the contaminated equipments and combs in soap solution containing 7 per cent formalin for 24 hours. Then wash the treated material with water dry and use.
 - 3) Disinfect the combs with UV rays in protected chambers/UV chambers where possible.

For effective diseases management

- Dusting of thymol @ 0.25 g powder/frame or use of pads soaked in formalin 65% is effective against mites and other diseases.
- Use of antibiotics to control honeybee diseases is likely to result in contamination of honey causing problems in export of honey.

Wasp control

- Maintain strong colonies with vigorous prolific queen.
- Reduce the size of the hive entrance and alighting board.
- Fitting of queen gate or queen guard board.
- Mechanical destruction of the wasp colonies by kerosene torches or carbryl spraying.
- Physical killing the wasps by fly flappers. Flapping regularly for half an hour keeps the wasps away for at least three hours
- Use physical barriers viz. wire gauge and bird scaring ribbons.
- Use baits/feeding attractants viz. Cypermethrin + rotten fish/Chicken/pear/ apple/ pumpkin/ banana/ pineapple/sweet candy

Varroa destructor Management

- The infestation is caused by an ectoparasitic mite (*Varroa destructor* Anderson & Trueman), which sucks the blood of larvae, pupae and adult bees. It is reddish brown measuring 1.1 to 1.2 mm long and 1.5 to 6 mm broad. It has 4 pairs of legs. The female enters the cell with 4-5 days old larvae and lays eggs there. Life cycle is completed in 8 to 10 days in females and 6 to 7 in males. It prefers drone brood over worker brood. Honey bee mites have been extremely destructive to honey bees. In different apiaries at Jammu & Kashmir, the loss has been to the tune of more than 80 per cent. Infestation ranged from 2-5 mites per blood cell.

Mode of spread:

1. Attachment to the bee in flight.
2. Carried by a robber bee
3. Drifting Bees
4. The spread of the varroa mite can also be accelerated through laid floral crop of marigold
5. Transport of hives by migratory beekeeping.
6. Infected bees being moved between colonies.
7. Where social structure has already been weakened by varroa.

These hives are more vulnerable to robber bees, which pick up and then disperse the mites to their own and other colonies.

Symptoms

1. Adult mite can be seen on bee's body surface.
2. Dead larvae, pupae, malformed workers and drones appear at hive entrance.
3. Spotty brood pattern.
4. A parasitized pupa appears to have small, pale or dark reddish spot on its body.
5. While droppings are seen on the walls of empty cells.
6. Some larvae die in the pre-pupal stage with characteristic raised heads.

Control of mites in the brood

A) Management practices

1. Prevention is better than cure.
2. Maintain proper hygiene of the colonies. Do not discard comb & propolis in the apiary or exchange combs.
3. Removal of the drone brood, limits the reproduction of varroa mite.
4. In case of severe infestation, interruption of the brood cycle by caging the queen for 7 days at intervals is recommended so that the bees can remove infected brood.
5. To avoid robbing and drifting of bees don't spill sugar syrup in the apiary.
6. Sterilize combs with 80% acetic acid and/or PDB.
7. Destroy drone application in the comb as varroa mite multiply more in drone cells
8. Clean the honey bee colony/comb

B) Control of mites on the bodies of the adult bees

Chemical Control

1. Sulphur dusting @ 1 g per frame at weekly intervals is recommended.
2. 180 ml of 98% formic acid is filled in a bottle and placed in an empty space above the brood or adjacent to the brood. The bottle is corked in such a way so as to regulate 10 ml of the acid to evaporate daily.
3. Fumigate with 1-2 strips of Chlorobenzilate per colony at weekly interval for eight weeks.
4. Hang Apistan strips vertically in between the frames inside the brood nest. One strip is effective for 6 to 8 weeks. As the mites develop resistance to Apistan very fast, do not use strips regularly*. Alternate treatments with other chemicals/oils etc.
5. 1 gm of thymol in powder form mixed with 10-15 gm of wheat flour per colony may be dusted on infested frames at weekly intervals. Repeated treatments with 0.25 gm of thymol powder dust in passages between the combs can control upto 98% mites.
6. Oxalic acid 3.5% + sugar 3.5% in 1 litre of water may be sprayed directly on top bars of the comb @ 2.5 ml/comb at fortnightly intervals.
7. Thymol powder dusting can be done in rainy season but strictly prohibited at honey flow time (March to May and October to November).

**The mite is highly resistant to chemical treatments. Therefore, try to avoid chemical treatments even if necessary, the repeated applications of the same chemical may be avoided.*

For disease diagnosis, suspected samples of diseased bees in paper packing may be sent to

AICRP (Honeybee and Pollinators), Division of Entomology, Faculty of Agriculture, SKUAST-J, Main Campus, Chatha, Jammu-180 009 (J&K).



Performa for Referring Sample to Plant Clinic

S.No.	Particulars	Details
1.	Name & Address of Farmer	_____ _____
2.	Agro climatic Zone	Subtropical/Intermediate/Temperate
3.	Growing condition	Irrigated/ Rainfed
4.	Source of Irrigation	Canal/Tube well/ NA
5.	Crop/ Variety/Stage of crop	
6.	Sowing date	
7.	Package of practice Followed	Fully/ Partial/Farmer's practice
8.	If partial Strike the practice not followed	Seed treatment/ Spacing/ Proper doses of Organic & Inorganic/ weed management
9.	Name of Inputs used	Dose; timings
10.	Area under crop	
11.	Source of Seed	
12.	Is problem related to weather	Yes/No
13.	Mention weather Stress	Rain/ Temp/ Storm/ Frost/ Dry spell/ Hail/Any other (Specify)
14.	Suspected Disorder	Insect damage/ Disease/Nutritional/ Input phytotoxicity/ Any other
15.	Symptoms	Holes/Excreta/ Rotting Blight/ Yellowing/ Wilting Mottling/mosaic/ Root swelling/distortion/any other(Specify)
16.	Extent of Spread	Less than 25%; 25-50%; 50-75%; more than 75%
17.	Spread pattern	Whole crop/patches/isolated plants
18.	Crop rotation	
19.	Soil Type	

20.	Soil/ water analysis report	Attached/ Not attached
21.	Drainage system	Good/ Moderate/ poor
22.	Irrigation applied	
23.	Industrial Plant in adjoining area	Yes/ No
24.	Distance from Industrial plant	
25.	Diagnosis by field functionaries of Agri. Dept.	
26.	Sample can also be sent to any of the addresses	<ol style="list-style-type: none"> 1. Directorate of Extension, SKUAST-J, Main Campus, Chatha Jammu -180 009 2. Krishi Vigyan Kendra, R.S. Pura, Jammu 3. Krishi Vigyan Kendra, Tandwal Rajouri 4. Krishi Vigyan Kendra, Qazi Morha, Poonch 5. Krishi Vigyan Kendra, Rajhani, Kathua 6. Krishi Vigyan Kendra, Tanda, Reasi 7. Krishi Vigyan Kendra, Gowari (Bhaderwah), Distt. Doda. 8. Krishi Vigyan Kendra, Arazi, Samba
27.	Sender's particular with Signatures & date of Submission	Name & Address:

List of Pesticides / Pesticides Formulations Banned, Refused Registration and Restricted in Use in India

I. PESTICIDES / FORMULATIONS BANNED IN INDIA (01.06.2023)

A. Pesticides Banned for manufacture, import and use.	
1.	Alachlor(Vide S.O. 3951(E), dated 08.08.2018)
2.	Aldicarb (vide S.O. 682 (E) dated 17 th July 2001)
3.	Aldrin
4.	Benzene Hexachloride
5.	Benomyl (vide S.O 3951(E) dated 8th August, 2018)
6.	Calcium Cyanide
7.	Carbaryl (vide S.O 3951(E) dated 8th August, 2018)
8.	Chlorbenzilate (vide S.O. 682 (E) dated 17 th July 2001)
9.	Chlordane
10.	Chlorofenvinphos
11.	Copper Acetoarsenite
12.	Diazinon (vide S.O 3951(E) dated 8th August, 2018)
13.	Dibromochloropropane (DBCP) (vide S.O. 569 (E) dated 25 th July 1989)
14.	Dichlorovos (Vide S.O. 3951 (E), dated 08.08.2018)
15.	Dieldrin (vide S.O. 682 (E) dated 17 th July 2001)
16.	Endosulfron (vide ad-Interim order of the Supreme Court of India in the Writ Petition (Civil) No. 213 of 2011 dated 13th May, 2011 and finally disposed of dated 10th January, 2017)
17.	Endrin

18.	Ethyl Mercury Chloride
19.	Ethyl Parathion
20.	Ethylene Dibromide (EDB) (vide S.O. 682 (E) dated 17 th July 2001)
21.	Fenarimol (vide S.O 3951(E) dated 8th August, 2018)
22.	Fenthion (vide S.O 3951(E) dated 8th August, 2018)
23.	Heptachlor
24.	Lindane (Gamma-HCH)
25.	Linuron (vide S.O 3951(E) dated 8th August, 2018)
26.	Maleic Hydrazide (vide S.O. 682 (E) dated 17 th July 2001)
27.	Menazon
28.	Methoxy Ethyl Mercury Chloride (vide S.O 3951(E) dated 8th August, 2018)
29.	Methyl Parathion (vide S.O 3951(E) dated 8th August, 2018)
30.	Metoxuron
31.	Nitrofen
32.	Paraquat Dimethyl Sulphate
33.	Pentachloro Nitrobenzene (PCNB) (vide S.O. 569 (E) dated 25 th July 1989)
34.	Pentachlorophenol
35.	Phenyl Mercury Acetate
36.	Phorate(Vide S.O. 3951(E), dated 08.08.2018)
37.	Phosphamidon(Vide S.O. 3951(E), dated 08.08.2018)
38.	Sodium Cyanide (banned for Insecticidal purpose only vide S.O 3951(E) dated 8th August, 2018)*
39.	Sodium Methane Arsonate

	40.	Tetradifon
	41.	Thiometon (vide S.O 3951(E) dated 8th August, 2018)
	42.	Toxaphene(Camphechlor) (vide S.O. 569 (E) dated 25 th July 1989)
	43.	Triazophos (Vide S.O. 3951 (E), dated 08.08.2018)
	44.	Tridemorph (vide S.O 3951(E) dated 8th August, 2018)
	45.	Trichloro acetic acid (TCA) (vide S.O. 682 (E) dated 17 th July 2001)
	46.	Trichlorfon(Vide S.O. 3951(E), dated 08.08.2018)
B.	Pesticide formulations banned for import, manufacture and use	
	1.	Carbofuron 50% SP (vide S.O. 678 (E) dated 17 th July 2001)
	2.	Methomyl 12.5% L
	3.	Methomyl 24% formulation
	4.	Phosphamidon 85% SL
C.	Pesticide/ Pesticide formulations banned for use but continued to manufacture for export	
	1.	Captafol 80% Powder (vide S.O. 679 (E) dated 17 th July 2001)
	2.	Dichlorvos (vide S.O. 1196 (E) dated 20th March 2020)
	3.	Nicotin Sulfate
	4.	Phorate (vide S.O. 1196 (E) dated 20th March 2020)
	5.	Triazophos (vide S.O. 1196 (E) dated 20th March 2020)
D.	Pesticides Withdrawn (Withdrawal may become inoperative as soon as required complete data as per the guidelines is generated and submitted by the Pesticides Industry to the Government and accepted by the Registration Committee. (S.O 915(E) dated 15th Jun, 2006)	
	1.	Dalapon
	2.	Ferbam

3.	Formothion
4.	Nickel Chloride
5.	Paradichlorobenzene (PDCB)
6.	Simazine
7.	Sirmate (S.O. 2485 (E) dated 24 th September 2014)
8.	Warfarin (vide S.O. 915 (E) dated 15 th June 2006)

- Regulation to be continued in the extant manner for non-insecticidal uses.

II. PESTICIDES REFUSED REGISTRATION

S.No.	Name of Pesticides
1.	2,4, 5-T
2.	Ammonium Sulphamate
3.	Azinphos Ethyl
4.	Azinphos Methyl
5.	Binapacryl
6.	Calcium Arsenate
7.	Carbophenothion
8.	Chinomethionate (Morestan)
9.	Dicrotophos
10.	EPN
11.	Fentin Acetate
12.	Fentin Hydroxide
13.	Lead Arsenate
14.	Leptophos (Phosvel)

15.	Mephosfolan
16.	Mevinphos (Phosdrin)
17.	Thiodemeton/ Disulfoton
18.	Vamidothion

III. PESTICIDES RESTRICTED FOR USE IN THE COUNTRY

S.No.	Name of Pesticides	Details of Restrictions
1.	Aluminium Phosphide	<p>The Pest Control Operations with Aluminium Phosphide may be undertaken only by Govt./ Govt. undertakings/ Govt. Organizations/ pest control operators under the strict supervision of Govt. Experts or experts whose expertise is approved by the Plant Protection Advisor to Govt. of India except ¹Aluminium Phosphide 15% 12 g tablet and ²Aluminum Phosphide 6% tablet.</p> <p><i>[RC decision circular F No. 14-11(2)-CIR-II (Vol. II) dated 21-09-1984 and G.S.R. 371(E) dated 20th may 1999].</i> ¹Decision of 282nd RC held on 02-11-2007 and, ²Decision of 326th RC held on 15-02-2012.</p> <p>The production, marketing and use of Aluminium Phosphide tube packs with a capacity of 10 and 20 tablets of 3 g each of Aluminium Phosphide are banned completely.</p> <p>(S.O.677 (E) dated 17th July, 2001)</p>
2.	Captafol	<p>The use of Captafol as foliar spray is banned. Captafol shall be used only as seed dresser. (S.O.569 (E) dated 25th July, 1989)</p> <p>The manufacture of Captafol 80% powder for dry seed treatment (DS) is banned for use in the country except manufacture for export. (S.O.679 (E) dated 17th July, 2001)</p>

3.	Cypermethrin	Cypermethrin 3% Smoke Generator, is to be used only through Pest Control Operators and not allowed to be used by the General Public. [Order of Hon'ble High Court of Delhi in WP(C) 10052 of 2009 dated 14-07-2009 and LPA-429/2009 dated 08-09-2009]
4.	Dazomet	The use of Dazomet is not permitted on Tea. (S.O.3006 (E) dated 31 st Dec, 2008)
5.	Dichloro Diphenyl Trichloroethane (DDT)	<p>The use of DDT for the domestic Public Health Programme is restricted up to 10,000 Metric Tonnes per annum, except in case of any major outbreak of epidemic. M/s Hindustan Insecticides Ltd., the sole manufacturer of DDT in the country may manufacture DDT for export to other countries for use in vector control for public health purpose. The export of DDT to Parties and State non-Parties shall be strictly in accordance with the paragraph 2(b) article 3 of the Stockholm Convention on Persistent Organic Pollutants (POPs). (S.O.295 (E) dated 8th March, 2006)</p> <p>Use of DDT in Agriculture is withdrawn. In very special circumstances warranting the use of DDT for plant protection work, the state or central Govt. may purchase it directly from M/s Hindustan Insecticides Ltd. to be used under expert Governmental supervision. (S.O.378 (E) dated 26th May, 1989)</p>
6.	Fenitrothion	<p>The use of Fenitrothion is banned in Agriculture except for locust control in scheduled desert area and public health.</p> <p>(S.O.706 (E) dated 03rdMay, 2007)</p>
7.	Methyl Bromide	<p>Methyl Bromide may be used only by Govt./ Govt. undertakings/ Govt. Organizations/ Pest control operators under the strict supervision of Govt. Experts or Experts whose expertise is approved by the Plant Protection Advisor to Govt. of India.</p> <p>[G.S.R.371 (E) dated 20th May, 1999 and earlier RC decision]</p>
8.	Monocrotophos	<p>Monocrotophos is banned for use on vegetables.</p> <p>(S.O.1482 (E) dated 10thOct, 2005)</p>

9.	Trifluralin	<p>(vide S.O 3951(E) dated 8th August, 2018)</p> <p>(i) The Registration, import, manufacture, formulation, transport, sell and its all uses except use in wheat shall be prohibited and completely banned from date of publication of this Order.</p> <p>(ii) A cautionary statement has to be incorporated in the label and leaflet that it is toxic to aquatic organism, hence should not be used near water bodies, aquaculture or pisciculture area.</p>
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Endosulfan*: Endosulfan has been banned by the supreme Court of India w.e.f. 13-05-2011 for production, use & sale all over India till further orders vide ad-Interim order in the Writ Petition (Civil) No. 213 of 2011

IV. PESTICIDES WHICH SHALL BE PHASED OUT VIDE GAZETTE NOTIFICATION NO. S.O. 3951 (E).

S.No	Name of the pesticide	Insecticides to be phase out by 31st December, 2020
1	Alachlor	<p>(i) No new certificate of registration to manufacture shall be issued after publication of this Order.</p> <p>(ii) No person shall import, manufacture or formulate Alachlor with effect from the 1st January, 2019.</p> <p>(iii) The use of Alachlor shall be completely banned with effect from the 31st December, 2020.</p> <p>(iv) It is toxic to aquatic organism, hence a cautionary statement should be incorporated on label and leaflets " toxic to aquatic organism hence should not be used near water bodies, aquaculture or pisciculture area.</p>
2	Dichlorovos	<p>(i) No new certificate of registration to manufacture shall be issued after publication of this Order.</p>

		<p>(ii) No person shall import, manufacture or formulate dichlorvos with effect from the January, 2019.</p> <p>(ii) The use of dichlorvos shall be completely banned with effect from the 31st December, 2020.</p> <p>(iv) It is very toxic to aquatic organism, hence a cautionary statement should be incorporated on label and leaflets that it is toxic to aquatic organism, hence should not be used near water bodies, aquaculture or pisciculture area.</p> <p>(v) A warning may be incorporated in the label and leaflet stating that this product is toxic to honey bees so do not spray during active honey bees foraging period of the day.</p>
3	Phorate	<p>(i) No new certificate of registration to manufacture shall be issued after publication of this Order.</p> <p>(ii) No person shall import, manufacture or formulate Phorate with effect from the 1st January, 2019.</p> <p>(iii) The use of Phorate shall be completely banned with effect from the 31st December, 2020.</p> <p>(iv) It is very toxic to aquatic organism, hence a cautionary statement should be incorporated on label and leaflets that it is toxic to aquatic organism, hence should not be used near water bodies, aquaculture or pisciculture area.</p> <p>(v) A warning may be incorporated in the label and leaflet stating that this product is toxic to honey bees so do not spray during active honey bees foraging period of the day. (vi) A cautionary statement should incorporate in label and leaflet that this product is toxic to birds.</p>
4	Phosphamidon	<p>(i) No new certificate of registration to manufacture shall be issued after publication of this Order.</p>

		<p>(ii) No person shall import, manufacture or formulate Phosphamidon with effect from the 1st January, 2019.</p> <p>(iii) The use of Phosphamidon shall be completely banned with effect from the 31st December, 2020.</p> <p>(iv) It is very toxic to aquatic organism, hence a cautionary statement should be incorporated on label and leaflets that it is toxic to aquatic organism, hence should not be used near water bodies, aquaculture or pisciculture area.</p> <p>(v) A warning may be incorporated in the label and leaflet stating that this product is toxic to honey bees so do not spray during active honey bees foraging period of the day.</p> <p>(vi) A cautionary statement should incorporate in label and leaflet that this product is toxic to birds.</p>
5	Triazophos	<p>(i) No new certificate of registration to manufacture shall be issued after publication of this Order.</p> <p>(ii) No person shall import, manufacture or formulate Triazophos with effect from the 1st January, 2019.</p> <p>(iii) The use of Triazophos shall be completely banned with effect from the 31st December, 2020.</p> <p>(iv) It is very toxic to aquatic organism, hence a cautionary statement should be incorporated on label and leaflets that it is toxic to aquatic organism, hence should not be used near water bodies, aquaculture or pisciculture area.</p> <p>(v) A warning may be incorporated in the label and leaflet stating that this product is toxic to honey bees so do not spray during active honey bees foraging period of the day</p> <p>(vi) A cautionary statement should incorporate in label and leaflet that this product is toxic to birds</p>

6	Trichlorfon	<ul style="list-style-type: none">(i) No new certificate of registration to manufacture shall be issued after publication of this Order.(ii) No person shall import, manufacture or formulate trichlorfon with effect from the 1st January, 2019.(iii) The use Trichlorfon shall be completely banned with effect from the 31st December, 2020.(iv) It is very toxic to aquatic organism, hence a cautionary statement should be incorporated on label and leaflets that it is toxic to aquatic organism, hence should not be used near water bodies, aquaculture or pisciculture area.(v) A cautionary statement should incorporate in label and leaflet that this product is toxic to birds.
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