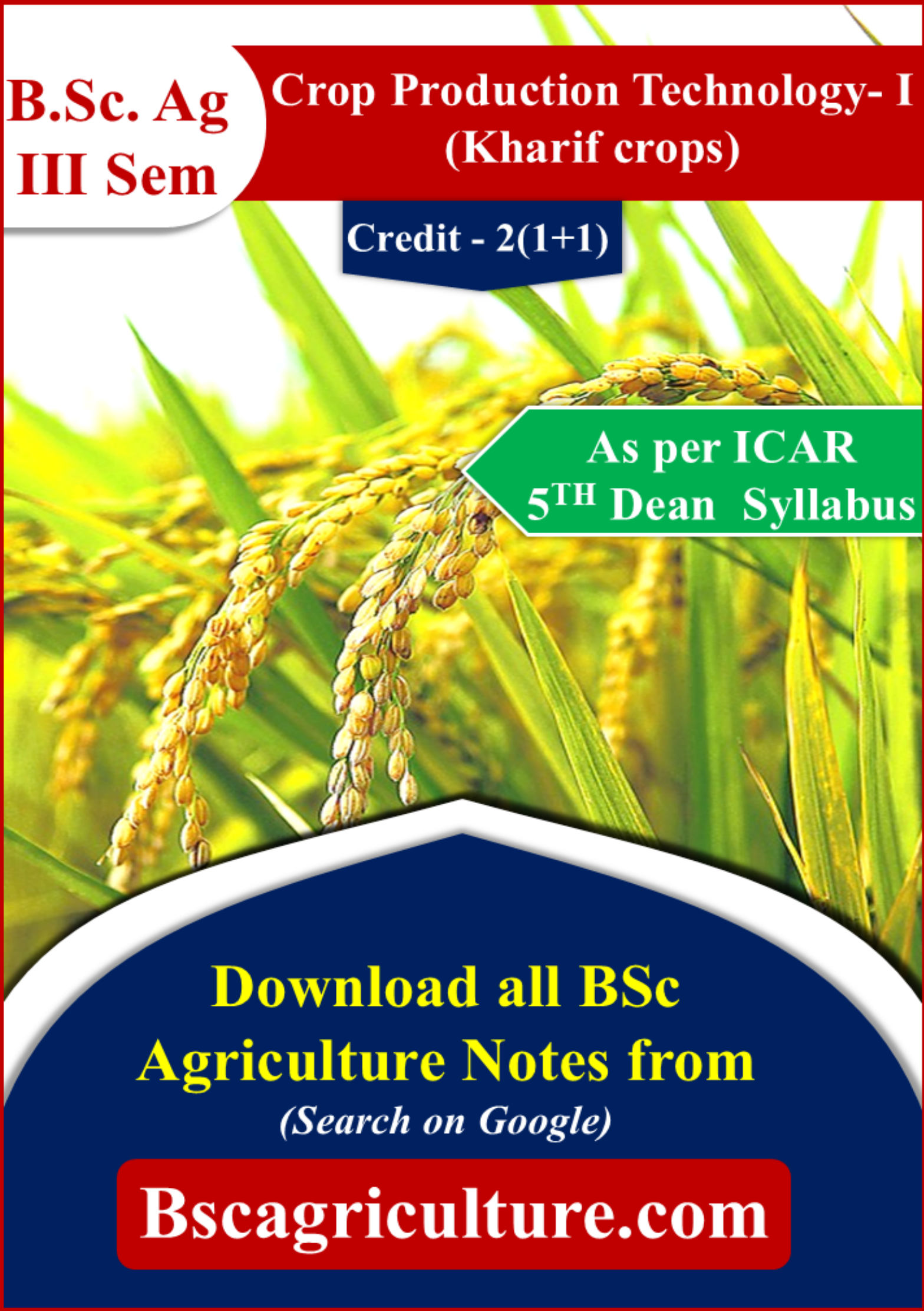
B.Sc. Ag
III Sem

Crop Production Technology- I
(Kharif crops)

Credit - 2(1+1)



As per ICAR
5TH Dean Syllabus

PACKAGE OF PRACTICES FOR KHARIF CROPS

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CONTENTS

S. No.	Particulars	Page No.
1.	**GRAIN CROPS**	**1-44**
	1.1 Rice	1
	1.1.1 Rice Cultivation in Sub-tropical zone (upto 800m above msl)	1
	1.1.2 Rice Cultivation in Intermediate (800-1500m above msl) and Temperate zone (above 1500m above msl)	16
	1.1.3 Direct Seeded Rice	24
	1.2 Maize	28
	1.3 Bajra	36
	1.4 Hybrid Jowar	39
	1.5 Lesser Millets	41-44
	1.5.1 Salan	41
	1.5.2 Kangni	42
	1.5.3 Cheena	43
2.	**OIL SEED CROPS**	**45-48**
	2.1 Sesamum	45
	2.2 Groundnut	46
3.	**PULSE CROPS**	**49-58**
	3.1 Moong and Mash	49
	3.2 Soybean	52
	3.3 Cowpea	54
	3.4 Rajmash	56
4.	**FODDER CROPS**	**59-77**
	4.1 Lucerne	59
	4.2 Hybrid Napier	60
	4.3 Cowpea	62
	4.4 Bajra	63
	4.5 Jowar	64
	4.6 Pionear Jowar	65
	4.7 Guara	65
	4.8 Teosinte or Makchari	66
	4.9 Deenanath Grass	67
	4.10 Kazungula Grass	68
	4.11 Subabool	69
	4.12 Green Fodder Round the Year	70
	4.13 Grass Land Management	72
	4.14 Silage making	74
5.	**CASH CROPS**	**78-83**
	5.1 Sugarcane	78
	5.2 Saffron	81
6.	**MILKY MUSHROOM**	**84-85**
7.	**APICULTURE**	**86-94**
8.	**INTEGRATED FARMING SYSTEM MODEL**	**95-97**
9.	**ANNEXURES**	**98-121**

1. GRAIN CROPS

1.1 RICE

To exploit the yield potential of the existing rice varieties, efficient management and adoption of appropriate technology is essential. To achieve this objective of harvesting high yield and judicious use of inputs, following improved practices are recommended for Jammu region:

1.1.1 Rice cultivation in Subtropical zone (upto 800m above msl)

Climate: Rice is basically a crop of humid tropics, but it varies widely in physiological adaptability, hence grown successfully both in tropical and temperate conditions up to an altitude of about 2250m above mean sea level. It is normally grown where rainfall during the crop season is around 650 mm or more. Under sub-tropical conditions of Jammu division, it is grown during *kharif* season where the temperature at sowing is higher (30-35°C) and slowly declines until maturity. Temperature beyond 30°C with high light intensity affects fertilization and grain filling. Moderately high temperature is congenial for vegetative growth, whereas the blossoming stage benefits from slightly lower temperature (20-25°C).

Soil: Rice grows well under varied soil conditions. Clay to clay loam soils, which turn into soft mud when puddled and develop cracks on drying, are most suitable for its growth. The rice soil with high percolation rate reduces the water use efficiency considerably. Therefore, rice cultivation needs careful attention in such soils.

Varieties: The following high yielding varieties of rice are recommended for different situations.

I. Sub-tropical areas under assured irrigated conditions (upto 800m above msl)

A. Coarse Varieties

SJR-5: It is resistant to leaf blast and moderately resistant to bacterial leaf blight, matures in 135 days with grain yield potential of 22-25q/acre.

Jaya: It is dwarf 82 cm long bold grained variety, susceptible to bacterial leaf blight, resistant to blast, matures in 135 days with grain yield potential of 20-24q/acre.

PR-113: Its average palnt height is about 105cm. Its grains are bold and heavy. It matures in 142 days after seedings. It is resistant to bacterial leaf blight. Its average grain potential yield is 28q/acre.

PHB-71: It is semi dwarf (115-120cm) long slender grained hybrid variety, tolerant to blast, matures in 130-135 days. Its grain yield potential is 32-35q/acre.

Semifine Varieties

Ratna: It is dwarf 85-90 cm long slendered grain variety, modetrately resistant to blast, matures in 130-135 days. Its potential grain yield is 18-20q/acre.

B. Fine Varieties

IET 1410: It is an early maturing variety which matures in 115-120 days. It is recommended for sub-tropical areas of Jammu, Kathua, Udhampur and Rajouri districts under assured irrigation. Its potential grain yield is 16-18q/acre.

Tawi (PC-19): It is dwarf 83-85 cm long bold grained variety, moderately susceptible to bacterial leaf blight, modetrately resistant to blast, matures in 130-135 days. Its potential grain yield is 18q/acre.

C. Superfine Varieties

Basmati-370: This variety is about 165 cm tall and lodge under high fertility conditions. Its grains are super fine, highly aromatic and elongate almost double upon cooking. It matures in about 150 days. It is susceptible to bacterial leaf blight. Its grain yield potential is 14q/acre.

Basmati 564: It is promising basmati strain having grains at par with that of basmati 370 having good aroma. It is resistant to lodging and other biotic stress. It matures 15 days early as compared to basmati 370.

Ranbir Basmati: It has long slender grains, quality at par with basmati 370. It matures in about 120-125 days having grain yield potential of 10-12q/acre. It is recommended for non-basmati growing ares in mid-hills of Rajouri, Udhampur and Poonach in addition to Jammu, Samab and Kathua districts.

Jammu Basmati 129: It has long slender grain of 7.3mm coupled with HRR (56.3%) amylase content (22.4%) and good aroma. It is resistant to lodging and moderterly resistant to stem borer and bacterial leaf blight. It matures 15 days earlier over basmati 370. Its average grain yield potential 16-18q/acre.

Pusa Basmati 1121: It is about 120cm tall. It possesses extra long slender grain with good cooking quality. It is photo period insensitive and mature in about 140 days after seeding. It is susceptible to bacterial leaf blight. Its grain yield potential is 16q/acre.

Pusa 1612: It is fine grained aromatic rice variety, resistant to blast disease and it takes 120 days to seed maturity. Its grain yield potential is 20q/acre.

Pusa Basmati 1728: It is highly resistant to bacterial leaf blight, matures in 140 days having average grain yield potential of 26q/acre.

II. Rainfed conditions (upto 1200m above msl)

1. **China-1039**: It is tall 115-120cm coarse grained variety with high head recovery matures in 130-140 days and its potential grain yield is 16-18q/acre.
2. **K-39 (SKAU-5)**: It is early maturing variety, tolerant to blast and lodging, highly cold tolerant with the grain yield potential of 20-22q/acre.

Promising Rice Based Cropping Systems:

1. Early rice based cropping systems

a.	Rice IET-1410 (1st June to 25th June transplanting)	Toria local (3rd week of September)	Late sown Wheat variety Raj-3765/ PBW-370 (2nd week of December)
b.	Rice IET-1410 (1st June to 25th June transplanting)	Potato: K-Sindhuri (3rd week of September)	Late sown variety Raj-3765/PBW-370 (2nd week of December)
c.	Rice IET-1410 (1st June to 25th June transplanting)	Potato: K-Sindhuri (3rd week of September)	Moong (PS-16/PS-7)/ Mash (Pant-U-26)/ Summer fodder (Cowpea + Maize + Chari) 15th March-15th April
d.	Rice IET-1410 (15th June to 15th July)	Mustard: RLM-198 (2nd fortnight of October)	Summer fodder (Cowpea + Maize +Chari)--- 15th March-15th April
e.	Rice IET-1410 (15th June to 15th July)	Berseem for fodder and seed production (Mid Sept. to end October)	-
f.	Rice IET-1410 (1st week of June)	Cauliflower: variety Snowball (Mid October)	French beans: variety Contender (Mid February)

2. Medium rice based cropping systems

a.	Rice variety PC-19/ SJR-5 (15th June to 15th July transplanting)	Wheat timely sown variety HD-2967/ DPW-621-50/ RSP-561 (7th November to 21st November)	Summer fodder (Maize+Cowpea+Charry)
b.	Rice variety PC-19/ SJR-5 (15th June to 15th July transplanting)	Wheat timely sown variety HD-2967/ DPW-621-50/ RSP-561 (7th November to 21st November)	Moong: PS-16/ PS-7 (15th April to 21st April)
c.	Rice variety PC-19/ SJR-5 (15th June to 15th July transplanting)	Berseem for fodder and seed production (Mid September to End October)	
d.	Rice variety PC-19/ SJR-5 (1st week of June)	Peas: Arkel (Mid October to Mid November)	Bhindi: Hisar unnat (Mid February to Mid March)

3. Late rice based cropping system

a.	Rice variety Jaya/ PR-113/ RR-8585(1st June to 30th June)	Wheat variety HD-2967/ DPW-621-50/ RSP-561 (7th Nov. to 21st November)	

4. Rainfed rice based cropping systems

a.	Rice variety K-39 (SKAU-5)/ China-1039 (with the 1st monsoon shower upto last week of May)	Wheat variety HD-1080/ Raj-3077/PBW-175 (November sowing)	
b.	Rice variety K-39 (SKAU-5)/ China-1039 (with the 1st monsoon shower upto last week of May)	Mustard (RLM-198)/Gram (GNG-469)/lentil (L 41-47/ L9-12) (2nd fortnight of October)	

Agronomic Practices for Transplanted Rice

A) Nursery raising and its Management

Nursery Land Preparation: Pulverize and level the soil thoroughly

Manuring of Nursery: Incorporate 15 kg of well rotten F.Y.M or Compost, 60 g of Urea and 50 g of D.A.P. per 10 sq.m of nursery bed. When F.Y.M. or compost is not available, mix 120 g urea and 100 g of DAP per 10 Sqm of nursery bed.

Preparation of Nursery Bed

a) **Dry method:** Prepare raised beds 10 to 15 cm high each 1.25 m wide and of any convenient length. Provide channels all around the beds to facilitate irrigation, weeding and drainage. This method is recommended for early sown areas. 1/10 to 1/15th ha area is required for sowing nursery for one hectare of rainfed area and 1/15 to 1/20th ha for irrigated conditions.

b) **Wet method:** Puddle the field thoroughly. Prepare leveled beds each 1.25 m wide and of any convenient length. This method is recommended for late transplantation areas.

Time of Nursery Sowing:

S.No.	Group	Variety	Optimum seeding period
1.	Early	K-39/ IET 1410	3rd to 4th week of May, however, sowing can be extended upto 3rd week of June.
2.	Medium	SJR-5	2nd to 3rd week of May, however sowing can be extended upto 3rd week of June.
3.	Late	Jaya	1st fortnight of May, however, sowing can be extended upto end of May.
4.	Rainfed	China-1039	On 1st shower of Monsoon for direct sowing. For transplanted crop early sowing is preferred.

Note: Farmers are advised to use invariably the certified seed to ensure safety from seed borne disease. Use 10% higher seed rate in intermediate to temperate areas for late group.

Seed Rate: For transplanting more than two seedlings per hill, use 16 kg of seed per acre for fine varieties such as IET-1410, Ratna and Tawi (PC-19) and 16-18 kg per acre for coarse varieties such as China-1039, K-39 and Jaya. However the seed rate can be reduced to 1/3rd in case of single seedling per hill. For hybrids, use seed rate of 6 kg/acre

Seed Treatment: Before treating the seeds, hand winnowing of seeds with "Chhaj" to remove the false smutted grains is essential. Before sowing treat the seeds with copper oxychloride @ 3g/kg of seed.

Sowing of Seed

Dry method: Sow the seeds in lines 5 cm apart and 3 cm deep. Cover the seeds with a thin layer of soil and irrigate upto 3/4th height of the seed bed. The first irrigation should be applied 5 days after germination of seeds. Again irrigate after 5 days of germination of seeds and keep water 1 cm deep in the beds. Drain the water

occasionally.

Wet method: Sow sprouted seeds uniformly on the wet seed beds. After the sprouts are 1-2 cm long, bed may be kept submerged with a shallow layer of water. Keep the beds free from weeds.

Nursery Care:

1. Keep the seedlings free from weeds either with hand weeding or by herbicide application i.e. butachlor 5G @ 1.5 kg/500m^2 after the emergence of first leaf in sprouted seeds or pretilachlor @ 20 g/500m^2 at 4 DAS.
2. In low-lying and water logged areas where thread worms and root weevil are the problems, broadcast Cartap hydrochloride 4G @ 8 kg/acre in the soil at the time of last ploughing.
3. Protect seedlings from leaf hopper and stem borer by applying Cartap hydrochloride 4G @ 8 kg/acre in 5-7.5 cm standing water and keep water standing at least for 72 hours after application when there are 5% dead hearts per sq.m.
4. In case of grass hopper attack, spray chlorpyriphos 20EC@ 2ml/litre of water or 2-3 sprays of spray of neem oil @ 5% after 21, 42 and 63 days after transplanting.
5. In case of seedling blight, spray the seedlings in the nursery with copper oxychloride @ 0.3%.

B). Transplanting and its Management

Land Preparation:

1. If possible, grow dhaincha as green manuring crop 1 and ½ months before transplanting in the field where rice is to be grown. Sow dhaincha seeds @ 24-26 kg/acre and incorporate full dose of D.A.P. as per recommendations for rice variety to be transplanted. Plough the green manure crop about 7-10 days prior to transplanting of rice seedlings and allow it to decompose in standing water.
2. In case, the green manure crop is not grown, plough the land after harvest of wheat crop with tawi plough (soil turning plough) and keep the soil open for few days. Before transplanting repair all bunds and again plough the land 2 to 3 times with disc harrow or desi plough. 10cm of irrigation water in the field needs to be applied and puddle it with puddler/disc harrow to obtain a fine puddle. Incorporate the basal dose of fertilizer during puddling.
3. If well decomposed F.Y.M. or compost is available, incorporate it thoroughly @ 6 t/acre in the soil after 1st ploughing and before subsequent ploughings.
4. Prepare a fine well leveled puddled field to reduce water loss through percolation. It has been found that puddling 3 times increases the soil moisture to 2.76 cm over 2 times puddling.

Fertilizers and Nutrient Management: For efficient use of chemical fertilizers, get

soil tested well in advance of transplanting from the soil testing laboratory and apply the recommended dose of fertilizers to crop accordingly. In absence of such tests following fertilizer schedule is recommended for soil of an average fertility.

Sl.No.	Variety	Nutrients (kg/acre)			
		N	P_2O_5	K_20	$ZnSO_4$
1.	IET-1410 & K-39	20	12	8	8
2.	China-1039	16	12	8	8
3.	Ratna	32	12	10	8
4.	SJR-5	48	24	10	8
5.	Jaya	48	24	12	8
6.	PHB-71 (Hybrid)	48	24	12	8
7	B 370/Ranbir basmati/B 564	12	8	4	-
8	PB1121/JB129/Pusa1612/PB1728	16	10	6	-

These plant nutrients can be made available from the following fertilizer combination:

Sl.No.	Variety	Fertilizer (kg/acre)			
		Urea	DAP	MOP	$ZnSO_4$
1.	IET-1410 & K-39	34	26	13	8
2.	China-1039	25	26	13	8
3.	Ratna	56	35	16	8
4.	SJR-5	84	53	16	8
5.	Jaya	84	53	20	8
6.	PHB-71 (Hybrid)	84	53	20	8
7.	B 370/Ranbir basmati/B 564	20	18	16	-
8.	PB1121/JB129/Pusa1612/PB1728	31	22	10	-

Note:

1. Zinc sulphate should be applied once in three years.
2. When full dose of phosphate is applied in wheat crop then reduce the quantity of phosphate by 25% to 50% in case of paddy.
3. Phosphatic fertilizer can be top dressed upto 30 DAT if not applied as basal dose.

Fertilizer Application:

1. When green manuring has been done the P should be applied to the green manure crop and full dose of K and 60% of the recommended dose of Nitrogen should be applied to the rice crop.
2. When FYM or Compost (6 tonnes/acre) has been applied, apply half of the recommended dose of N, P and K to the rice crop & rest half will be made available to the crop from the already added FYM or compost.
3. Apply full quantity of DAP, MOP and Zinc Sulphate alongwith 1/3rd of N from Urea at the time of puddling and incorporate fertilizers in the soil thoroughly, along with $ZnSO_4$, remaining N be top dressed in two equal splits-one at tillering

stage i.e. 25-30 days after transplanting and the another just before the panicle initiation stage. Drain off the water if possible before top dressing of fertilizer.

4. If in the standing crop yellowing of leaves from tips is noticed at any stage before flowering, the crop may be sprayed with a mixture of 1.2 kg of Zinc Sulphate, 6 kg Urea and 400g of Zineb/acre in 200 L of water with Knap Sack spray pump.
5. In case, the Zinc Sulphate has not been applied during the land preparation and symptoms of Zinc deficiency are noticed in the standing crop, the recommended dose of Zinc Sulphate may be mixed with equal quantity of dry soil and broadcast it in the affected fields.
6. In rice-wheat cropping system, yield stability & improvement in soil health can be brought about with the application of 50% recommended N through inorganic fertilizers and 50% through FYM in rice & 100% recommended NPK through inorganic fertilizers in wheat.
7. Use of leaf colour chart (LCC**):** Use LCC for need based nitrogen application to the paddy. Use of LCC can help avoid excessive use of nitrogen which is now a days polluting the soil as well as water. Apply 24 kg/acre of Urea as a basal dose after the completion of puddling operation. Match the colour of the youngest fully expanded leaf without any disease symptoms (2^{nd} from top) of at least 10 randomly selected free rice plants with the colour strip of the leaf colour chart every 7-10 days starting from 2 week~~s~~ after transplanting of paddy till the flowering stage. Every time while matching the leaves with the strips of LCC if the greenness of 6 out of 10 leaves is less than the shade '4' on the leaf colour strip, top dress 30 kg Urea/acre. If the colour of 5 or more out of 10 leaves is greener than the shade '4' on the LCC strip, do not apply any urea to paddy. Use of LCC holds good for almost coarse varieties of paddy grown in all types of soils. Even if FYM is used, use of LCC gives good result in knowing the nitrogen need of the crop and thus help in avoiding the excessive use of nitrogen.

   Zn deficiency: The symptoms of Zn deficiency normally appears 2-3 weeks after transplanting. The lower leaves become rusty brown in colour near the base and ultimately starts drying up. Once the deficiency symptoms are noticed in the fields apply $ZnSO_4$ immediately. In highly deficient soils broadcast 12 kg/acre of $ZnSO_4$ (Heptahydrate) or 7kg/acre of $ZnSO_4$ (Monohydrate) mixed with an equal quantity of dry soil on the affected patches.

   Iron deficiency**:** Under moisture deficient conditions, chlorosis among seedlings appears in the youngest leaf about 3 weeks after transplanting. Plants die, and often the crop fail completely. Give copious irrigation as soon as possible once chlorosis appears. Application of 2 or 3 sprays of 1% $FeSO_4$ solution at weekly intervals (1.2 kg of $FeSO_4$ in 40 L of water/acre).

8. In case of unavailability of FYM - alternatively *Leucaena* biomass @ 1 t/acre on dry wt. basis be applied at the time of puddling of rice crop.

9. Crop Residue Management**:**

i) For incorporation of Rice and Wheat straw, the practice recommended is given as follows. 2t/acre of rice straw in wheat and 2t/acre wheat straw in rice (on dry wt. basis) needs to be chopped (each piece of about 5 cm in length) and spread across the plots and incorporated by the tractor or bullock driven plough up to 8 cm soil depth. Application of *Trichoderma viridi* cultured separately with FYM (10g/kg of FYM) for 14 days with constant moisture supplied at regular intervals to maintain a sufficient multiplication of micro-organisms. This cultured FYM @ 1 kg/5 t of crop residue is recommended for application in the field. Application of 17.3 kg urea/acre as a starter dose at the time of incorporation is recommended in addition to recommended schedule of fertilizers. The incorporation of residue should be done 10 days before sowing/transplanting. The similar method of residue incorporation is advocated in other crop residues.

ii) Left over stubbles: Generally, the stubbles left in the field after harvesting with the Combine harvester needs to be incorporated. After the harvest of the crop the field is ploughed and stubbles are incorporated. For enhancing the decomposition of the stubbles, the cultured FYM with *Trichoderma viridi* @ 4 kg/acre has to be applied with a starter dose of N @ 1kg/500m^2 at sowing/transplanting.

Age of Seedlings at Transplanting: To obtain the best results, rice seedlings should be transplanted when they have attained 4 to 6 leaves stage. Such stage generally comes in early and medium groups of rice varieties like IET-1410, China-1039, Ratna and Tawi in about 25 days after sowing of seeds while in late group like Jaya, PR-113 in 25-30 days after sowing.

Note: Physiological age (4 to 6 leaves/seedling) is more important than chronological age (days a14fter sowing) for obtaining the best results.

Time of Transplanting: For getting maximum yield of rice, transplant rice seedlings from 20 June to 5 July. In typical water logged area where inundation of water takes place just after first heavy showers in the month of July, the transplanting of Basmati rice should be completed from 15th June to July. In other areas, the transplanting should be completed from 1st of July to 10th of July. In sub-tropical plain irrigated area sometimes it so happens that monsoon rains are delayed and irrigation water from canal becomes insufficient for transplanting of rice in time on large scale. And in some areas, where summer fodder cultivation is done, the land for rice transplantation is vacated late. Under such situations, it calls for contingent plans for delayed transplanting of rice to get economic return for which the following schedule may be adopted:

Sl.No.	Variety	Delayed date of transplanting	Age of seedling
1.	IET-1410	Upto 21st July	4 to 5 weeks old
2.	PC-19/ SJR5	-do-	6 to 7 weeks old
3.	Jaya/ SJR5	-do-	7 to 8 weeks old
4.	Basmati-370	1st week of August	7 to 8 weeks old

Uprooting of Seedlings: Irrigate the nursery before uprooting. Wash the seedlings in the water to remove mud.

Transplanting of seedlings: When puddle settles, transplant the seedlings 3 to 5 cm deep. Transplanting of seedlings at optimum depth ensures better establishment of plants and early tillering. Plant 2-3 seedlings per hill.

Following spacing for different varieties are recommended:

i) Jaya, China-1039 and K-39	20cm from row to row, 15cm from plant to plant or 15x15 cm
ii) IET-1410, Ratna, Tawi , SJR 5 and Basmati	20 cm from row to row, 10 cm from plant to plant

Irrigation Water Management: Precise land levelling through laser levelling is prerequisite for effective application of irrigation and water management at different depths. Apply and maintain 5cm water depth upto 5 days after transplanting and start irrigation when hair size cracks develop on soil. Follow alternate wetting and drying thereafter till maturity. Alternatively, apply 7cm irrigation depth once in 8 days after 5 days of transplanting during non-rainy days and stop irrigation three weeks before harvest for uniform and early ripening of the crop. Irrigations to rice should be applied when the soil moisture potential measured with tensiometer installed at 15cm depth reaches 15 centibar. Also, irrigation can be applied as: one irrigation of 10cm depth for puddling; two irrigations 5-7 cm depth during stand establishment period of two weeks and 7cm irrigations once in eight days during non-rainy periods after stand establishment period until two weeks before harvest.

Basmati rice is suitable for typical water logged areas where no drainage facilities are available and where crop remains submerged. However, in case of light textured soils of irrigated areas where the in situ green manuring practice is done, irrigation schedule of 7 cm depth at 3 days after the disappearance of ponded water needs to be regulated.

Weed Control:

Interculture: To remove weeds, two weedings are important. If the crop has been transplanted in lines, interculture with a rice weeder may be done by running it in between the crop rows i.e. first weeding or hoeing 15 days after transplanting and second operation after 30 days after transplanting. In case, the crop has not been transplanted in lines, two hand weedings may be given as per above time schedule.

Chemical Weed Control: Weeds can effectively be controlled by applying any of the following herbicides:

1. Apply butachlor granules 5 G @ 12 kg/acre. Where there is no problem of stagnation of water in the field apply granules just after transplanting otherwise apply the granules 4 to 6 days of transplanting in standing water 2-3 cm, deep. Do not drain the field for one week after application of granules. Granules should be applied uniformly in well leveled land otherwise desired results will not be achieved.
2. Apply anilophos (30% EC) + ethoxy sulfuron (10% EC) @ 500 +60 ml/acre at 10 DAT.
3. Add 1.2 litre of butachlor 50 EC in 60 kg/acre of sand and broadcast in standing water within 2 DAT.
4. Apply bispyribac sodium @10-12 ml/acre in 200 litre of water as post-emergence herbicide at 25-30 DAT. The higher dose is recommended under heavy type of soils (high organic matter) whereas light soils may be applied with lower dose for better efficacy of the herbicide. Before spray, the standing water from the field should be drained out and irrigation may be applied 1-2 days after spraying the herbicide.
5. Application of penoxulam @ 9 g/acre at 10 DAT followed by bispyribac @ 10-12 ml/ acre 30 DAT will prove efficient in controlling of all categories of weeds (grasses, sedges and broad leaved weeds).

Note: Use hand gloves while applying butachlor granules.

Weedy rice management in transplanted rice

The stale seed-bed with glyphosate @ 0.6 kg/acre or paraquat @ 0.32 kg/acre have been found as most effective and economical method for control of the weedy rice in transplanted rice

Method of herbicide application

1. Irrigate the field after harvest of rabi sown crop
2. Plough the land when it comes to optimum moisture
3. Apply glyphosate @ 0.6 kg/acre or paraquat @ 0.32 kg/acre using 200 litres of water on germinated weedy rice plants.

This process must be completed well before 10-15 days of transplanting

Harvesting & Threshing: Harvest the crop when 80% of the grains in a panicle are of golden colour. Thresh the crop immediately after harvesting by hand thresher or with the help of bullocks. Dry the produce in shade for safe storage.

I. Promising Rice Based Cropping Systems under Subtropical irrigated conditions of Jammu region.

A. Rice (PC-19)- Marigold (Pusa Narangi) - French bean (contender) sequence.

Agronomic practices	***Kharif***	***Rabi***	**Summer**
Crop sequence	Ric (PC-19)	Marigold(Pusa Narangi)	French bean(Contender)
Date of sowing	10th July to 20 July	10th Oct. to 20th Oct.	25th Feb. to 1st March
Method of sowing	Transplanting	Transplanting	Line sowing
Seed rate	16 kg/acre	400 g/acre	34 kg/acre
Spacing	20 cm × 10 cm	40 cm × 40 cm	60 cm × 10 cm
FYM	-	3 t/acre	3 to 4 t/acre
Fertilizer $N:P_2O_5:K_2O$ (Urea: DAP:MOP kg/acre)	48:24:10 (Urea-84: DAP-53: MOP-16)	48:24:10 (Urea-84: DAP-53: MOP-16)	20:40:20 (Urea-9: DAP-87: MOP-34)
Irrigation	9	4	4
Weed control	Butachlor 50 EC @ 1.2 litre/acre or Butachlor 5% G @ 12 kg/acre	Hand weeding	Hand weeding
Harvesting date	5-10 Oct.	15-20 Feb.	15-20 May
Yield	13-14 q/acre	16-17q/acre	24-26 q/acre

Risk factor involve**:** In case of severe cold there is apprehension of frost injury to marigold which may be minimized by the application of irrigation and smoking around the field by changing the micro-climate

B. Rice (IET-1410) - Potato (K. Badshah) - Onion (N-53) sequence

Agronomic practices	***Kharif***	***Rabi***	**Summer**
Crop sequence	Rice (IET-1410)	Potato (K. Badshah)	Onion (N-53)
Date of sowing	10th July to 20 July	10th Oct. to 20th Oct.	15th Jan. to 20th Jan.
Method of sowing	Transplanting	Ridge sowing	Transplanting
Seed rate	16 kg/acre	8q/acre	4 kg/acre
Spacing	20 cm × 10 cm	60 cm × 20 cm	10 cm × 7.5 cm
FYM	-	3 to 4 t/acre	3 to 4 t/acre
Fertilizer $N:P_2O_5:K_2O$ (Urea: DAP:MOP kg/acre)	24:8:8 (Urea-46: DAP-17: MOP-17)	48:24:48 (Urea-84: DAP-53: MOP-79)	40:20:20 (Urea-70: DAP-43: MOP-33)
Irrigation	9	3	3
Weed control	Butachlor 50 EC @ 1.2 litre/acre or Butachlor	Hand weeding	Hand weeding

	5% G @ 12 kg/acre		
Harvesting date	1-5 October	10-15 January	15-20 May
Yield	13-14 q/acre	60-80 q/acre	56 q/acre

C. Rice (IET-1410) - Cabbage (Golden acre) - Onion (N-53)

Agronomic practices	***Kharif***	***Rabi***	**Summer**
Crop sequence	Rice (IET-1410)	Cabbage (Golden acre)	Onion (N-53)
Date of sowing	10th July to 20 July	13th Oct. to 15th Oct.	10th Jan. to 15th Jan.
Method of sowing	Transplanting	Transplanting	Transplanting
Seed rate	16 kg/acre	240 g/acre	4 kg/acre
Spacing	20 cm × 10 cm	45 cm × 45 cm	10 cm × 7.5 cm
FYM	-	8 to 10 t/ha	8 to 10 t/ha
Fertilizer N:P_2O_5:K_2O (Urea: DAP:MOP kg/acre)	24:8:8 (Urea-46: DAP-17: MOP-17)	48:24:48 (Urea-84: DAP-53: MOP-79)	40:20:20 (Urea-70: DAP-43: MOP-33)
Irrigation	9	4	4
Weed control	Butachlor 50 EC @ 1.2 litre/acre or Butachlor 5% G @ 12 kg/acre	Hand weeding	Hand weeding
Harvesting date	1-5 Oct.	28-30 Dec.	10-15 May
Yield	13-14 q/acre	32-34 q/acre	60 q/acre

II. Rice Based Site Specific Nutrient Management under subtropical irrigated conditions of Jammu region.

Site specific nutrient management has played a key role in boosting the productivity of hybrid rice-wheat cropping system and is having the potential to increase the overall productivity in a system with maintaining/ sustaining soil fertility status besides enhancing nutrient response to crops under subtropical condition of Jammu region. The below mentioned recommendations are based on the specific initial nutrient availability of the soil.

Initial values: pH= 8.7 CEC<=12.1 me/100cm^3 available (kg/ha) N=240, P=40.32, K 113.12kg, sulphur=7.84, Boron=1.34, Cu=4.59, Fe=48.16, Mn=11.65, Zn=1.57, Ca/Mg ratio=3.3, Mg/K ratio=23, clay loam soil for achieving targeted productivity of 6t/acre under rice-wheat system.

Agronomic management practices

Agronomic practices	***Kharif***	***Rabi***
Crop sequence	Hybrid Rice (PHB-71)	Wheat (HD-2967)
Date of sowing	1st fortnight of July	5th to 10th November
Method of sowing	Transplanting (2 seedling/hill)	Line sowing

Seed rate	12 kg/acre	40 kg/acre
Spacing	20 cm × 15 cm	20 cm
FYM	5 t/ha	--
Fertilizer (kg/acre)*	60N:40P_2O_5:32K_2O (Urea- 96: DAP-87: MOP-53):20S :16 $ZnSO_4$: 8 $MnSO_4$	60 N:40P_2O_5:32K_2O (Urea- 96: DAP-87: MOP-53)
Irrigation	10	5
Weed control	Butachlor 50 EC @ 1.2 litre/acre or Butachlor 5% G @ 12 kg/acre	Metribuzin @ 80g/acre
Harvesting date	20th -28th Oct.	1st week of May

*All the fertilizers above shall be applied as basal dose. N should be applied in 3 equal splits.

III. Crop establishment Methods in Rice-Wheat system.

A.Agronomic management, profitability and efficiency through paddy hand transplanter and bed planting

Agronomic practices	Kharif	Rabi
	Rice (Jaya)	Wheat (HD-2967)
Date of sowing	1st fortnight of June	1st to 10th November
Method of sowing	Paddy power transplanter/hand Transplanter*	Bed Planting
Seed rate	14 kg/acre	40 kg/acre
Spacing	20 cm × 15 cm	20 cm
FYM	2 t/acre	--
Fertilizer (kg/acre)	N (Urea) P_2O_5 (DAP) K_2O (MOP) 48 (84) 24 (53) 12 (20)	N (Urea) P_2O_5 (DAP) K_2O (MOP) 40 (70) 20 (43) 8 (13)
Irrigation	09	05
Weed control	Butachlor 5 G (12kg/acre) at 3 DAT or Pyrozosulfuron @ 8 g/acre at 10 DAT	Metribuzin 80 g/acre
Harvesting date	Second fortnight of October	1st week of May
B:C Ratio	1.59	2.30
Labour saving (%)	19	17

***Mat nursery sowing method under paddy hand/power transplanter:** Commonly known as dapog nursery method. In this kind of nursery raising, farmer does not require large area. This method require more care, it saves water and cost involved on nursery uprooting. For this technique, an iron frame is used for nursery raising and 100 m^2 area is required for 1 ha. Before sowing of paddy seed, a mixture of sieved soil and FYM/vermicompost in equal proportion (1:1), urea @ 60g and DAP 50g/10 m^2 is required. A polythene sheet of suitable size is required to avoid the contact of grounded soil with iron frame. Place the iron frame on polythene sheet and fill the rectangles with a thin layer of prepared mixture of soil and FYM. Place the wet paddy seeds @ 500 g/frame uniformly. Seed bed is irrigated to 1-2 cm water

depth frequently for 7 to 10 days. Paddy straw in a thin layer is spread over the dry sown seeds to incubate them for early sprouting. Remove paddy straw after 4-5 days of sowing. One hand weeding at 12 days after sowing is required and nursery is ready for transplanting after 15-20 DAS. The width of the bed should be 1.2 m and length is adjustable as per convenience.

B. Agronomic management, profitability and efficiency under direct wet seeding through 8 rows drum seeder in rice and bed planting method in wheat

Management practices	**Kharif**	**Rabi**
	Rice (Jaya)	**Wheat (HD-2967)**
Date of nursery sowing	1st fortnight of June	1st to 10th Nov
Date of transplanting	25-30 days after nursery sowing	-
Method of sowing	8 rows drum seeder (wet seeding)*	Bed Planting
Seed rate	28 kg/acre	40 kg/acre
Spacing	20 cm × 15 cm	20 cm
FYM	2t/acre	--
Fertilizer (kg/acre)	N (Urea) P_2O_5 (DAP) K_2O (MOP) 48 (84) 24 (53) 12 (20)	N (Urea) P_2O_5 (DAP) K_2O (MOP) 40 (70) 20 (43) 8 (13)
Irrigation	10	5
Weed control	Pretilachlor @ 200 g/acre at 4 DAS or Pyrozosulphuron at 7 DAS @ 8 g/ acre followed by bispyribac 10 ml/acre at 25 DAS	Metribuzin 80g/acre
Harvesting date	Second fortnight of october	1st week of May
B:C Ratio	1.53	2.30
Labour saving (%)	24	17

***Method of aerobic wet seeding through drum seeder:** Pre-germinated seeds (24 hrs soaking+12hrs incubation) are sown 1-2 days after puddling, using a perforated drum seeder. A shorter incubation time (12 hrs) is critical for easy flow of sprouted seeds. The water should be drained before seeding and the mud should be firm enough to support the seeder and to make shallow furrows for sowing. The seeder must be pulled backwards. Drum seeding requires two persons per day.

Note: Under drum seeding of rice major problem realized was control of weeds. However, application of pretilachlor @ 200g/acre at 4 DAS or pyrozosulfuron @ 8 g/acre at 7 DAS followed by bispyribac sodium @10 ml/acre has shown the good results in keeping the population of the weeds below threshold level.

IV. System of Rice Intensification

The System of Rice Intensification basically refers to a particular set of practices which improve plant health and yield. It involves a set of practices for plant, soil, water and nutrient management.

Benefits of SRI

- Cost of cultivation is less in SRI but initially it requires more labour for transplanting. Less seed rate, less water requirement, less fertilizer and no herbicide mechanical (cono) weeding reduces cost of cultivation
- Saves time due to easy uprooting of nursery and 7-10 days early maturity
- As the SRI methodology requires less chemical inputs and emphasized on use of organic manures thereby negate ill effects of chemical input. SRI improves soil microbial health as aeration is improved through conoweeding, thereby improving soil macro and micro fauna
- SRI saves irrigation water as alternating wet and dry cycle is practiced
- The water saved for rice can be effectively used for increasing the area under rice or other irrigated dry crops in the cropping sequence.

Methodology of SRI

Raising seedlings and nursery management:

- Area: 40 m^2 nursery area is required for one acre area.
- Prepare two number of nursery beds of 8 X2.5 m^2 size with FYM and soil mixture of 2:1 ratio for one acre area.
- Nursery bed should be raised 12.5-15 cm in height along with bunds and channels. The bed should be prepared near the main field.
- 3.2 kg per acre pre-germinated rice seed should be sown through broadcasting and cover with FYM and soil mixture.

Irrigate the beds twice daily with rose cane

Preparation of main field, nursery uprooting and transplanting

- Field should be leveled; puddle and standing water should be drained out before transplanting
- Use any rope marked with 25 cm distance for facilitating square transplanting of seedlings @ 16 seedlings per square m
- Transplant 8-12 days old seedlings (2-3 leaf stage). Nursery should be uprooted through steel plate by inserting below the seed bed to get seedlings intact with seed and soil without damaging roots
- Single seedlings with soil should be transplanted gently at shallow depth at 25 cm distance. Interval between uprooting and transplanting should be minimum (not beyond an hour)

Water management

- Subsequent irrigations (2-2.5 cm) were given when soil developed fine hair line cracks
- Maintain shallow submergence (2.5 -3 cm) from panicle initiation up to 15 days before harvesting

However, there should be a thin film of standing water while operating the weeder and same water is retained for weed incorporation

Nutrient management

- Apply half of the recommended N and total P and K as basal before puddling and incorporate. Apply the second dose (25 %) of N at the time of 2nd weeding (20 DAT) and final dose of 25% N a week before panicle initiation.
- Different sources of organic manures should be use rather than single source. It also helps in suppressing population of harmful plant parasitic and promoting buildup of beneficial microbial.

Quantity of organic manures can be adjusted in such a way to supply recommended dose of N through different sources of organic manure.

Weed management: Conoweeding helps in replenishing the nutrients through incorporation of weeds, increased aeration and microbial activity thereby improving plant as well as soil health. First weeding with shallow standing water at 10-12 days after transplanting and a minimum 3 weedings at 10-12 days interval is required

1.1.2 Rice cultivation in Intermediate (800-1500m above msl) and Temperate Zone (above 1500m above msl)

Rice is also cultivated in cold and warm temperate regions of Jammu division comprising some parts of Doda, Udhampur, Rajouri, Poonch and Kathua Districts. To boost the rice production in this region, following improved agricultural practices are recommended.

Climate:

In the temperate areas, rice crop is sown at low temperature (14-20°C), it completes its early growth period stage in rising temperature (20-25°C) and after flowering it completes the growth in declining temperature (24-25°C). For tillering optimum day temperature is 32 to 34°C, low night temperature (16-21°C) except during tillering and the late ripening, favours grain production. Temperature in rice fields at active vegetative stage below 20°C affects the crop adversely. As such in low temperature areas in the hills, it is advisable to pond the water for several days to increase the temperature instead of allowing the water to flow from one terrace to another.

Soil: Rice grows on low-lying to upland soils. Clay to clay loam soils which turn into soft mud when puddled and develop cracks on drying, are the best soils for rice cultivation.

Varieties:

Following improved high-yielding varieties are recommended for cultivation:

1. **K-39 (SKAU-5):** It is early maturing variety, tolerant to blast and lodging, highly cold tolerant with the grain yield potential of 20-22q/acre. It is recommended for parts of Poonch, Doda, Rajouri, Udhampur and Kathua districts which fall between 900-1500 m height from mean sea level and having Southern aspect.
2. **Giza-14:** It is semi dwarf (90-95cm) short bold and coarse grained variety, matures in 140-150 days. It is recommended for Rajouri, Poonch District, Sangldan & Gool area of Udhampur District, Upper areas of Billawar block where occurrence of hail-storm is frequent (900-1350 m altitude) having grain yield potential of 20-22q/acre.
3. **China-1039:** It is tall 115-120cm coarse grained variety with high head recovery matures in 130-140 days and its potential grain yield is 16-18q/acre. It is recommended in area falling between 900 to 1550 m amsl.
4. **K-343 (SKAU-23/Chenab):** It is coarse grained variety, resistant to blast and cold tolerant, matures in 135-140 days with grain yield potentail of 20-22q/acre.
5. **K-448 (SKAU-27/ Jhelum):** This is a semi dwarf high yielding variety having plant height of 117cm and is grown over an altitude of about 1650 amsl. Its average grain yield poential is 24-26q/acre.
6. **Barkat (K-78).** It is semi dwarf (90-95cm) short bold grained variety, susceptible to blast and tolerant to cold, matures in 135-145 days having grain yield potential of 18-20q/acre. It is recommended upto 1800 m above mean sea level.
7. **K-332:** It is lodging resistant variety matures in 130-140 days, resistant to blast and averge grain yield potential is 16-18q/acre. It is suitable above 1800 m above mean sea level.

Crop Rotation: Following crop rotations are recommended altitude-wise.

1.	900-1350 m	Rice –Wheat Rice -Sarson/Barley/Lentil Rice -Oats Rice -Vegetable peas Rice –Berseem
2.	1350-1500 m	Rice -Sarson/Barley Rice -Oats Rice -Peas (Vegetable)
3.	1500-1650 m	Rice -Sarson/Peas/Barley

Agronomic Practices

Sowing Time: April is the optimum time for sowing of nursery but for higher altitude, sowing should be done in last week of March to last week of April depending upon suitable weather conditions.

Seed Rate: Use 20-24 kg of seed for raising seedlings for transplanting in a acre.

Seed Treatment: Same as mentioned under seed treatment for sub-tropical rice.

Nursery Raising: Incorporate 15 kg of well rotten F.Y.M. or Compost, 60 g of Urea

and 50 g of D.A.P. per 10 sq m. area. In case of wet sowing, puddle the land thoroughly and prepare beds each 1.25 m wide and of any convenient length. Provide channels all around the seed beds. Soak the treated seeds for 25 hours. Incubate the seed in warm moist conditions for 36 to 48 hours till germination occurs.

Broadcast the sprouted seeds in the puddled seed beds uniformly. Keep the beds moist but not flooded for the first few days. When the sprouts are 1-2 cm long, beds may be kept submerged with a shallow layer of water and keep the beds free from weeds.

Land Preparation: To obtain optimum tilth of the land, plough once with soil turning plough (Tawi plough) followed by 1-2 ploughings with desi plough or soil stirring plough. Irrigate the land and puddle the soil with a puddler or disc harrow (4 disc).

Fertilizers and Nutrient Management : Soil should be got tested from the nearest soil testing laboratory before transplantation and apply fertilizers as per soil test result. However, in absence of such test, the following schedule of fertilizers is recommended for medium fertility.

Variety	Nutrients (kg/acre)			
	N	P_2O_5	K_2O	Zinc Sulphate
China-1039	24	16	8	8
Other varieties	32	16	8	8

The above plant nutrients can be met from the following fertilizers:

Variety	Nutrients (kg/acre)			
	Urea	DAP	MOP	Zinc Sulphate
China-1039	38	36	13	8
Other varieties	56	36	13	8

NOTE: Zinc Sulphate should be applied wherever deficiency is noticed.

Fertilizer Application: When 6 tonnes of F.Y.M. or Compost is applied/acre, apply one half of the recommended dose of N.P. and K and rest half will be available from the F.Y.M. or Compost. Apply full quantity of D.A.P., MOP and Zinc Sulphate along with 1/3rd of total N through Urea at the time of puddling and incorporate into soil thoroughly. Broadcast the remaining 2/3rd Urea in two equal splits-one 30 days after transplanting (DAT) & the other 50 DAT. Drain off the water if possible, before application of second and third dose of nitrogen and re-irrigate the crop after 24 to 36 hours of fertilizer application.

Optimum Time for Transplantation: Transplant the seedlings when they have attained 4 to 5 leaf stage.

Method of Transplanting: Transplant the seedlings in lines. Put 2-3 seedlings per hill.

Irrigation Water Management: Irrigation depth after transplanting should be maintained at 3-4cm and can be increased to 6cm at establishment phase. Drain the water from field now and then during tillering phase but avoid draining the field at flowering stage. Top-dressing of the fertilizers should be done after 12-24 hours of draining and re-irrigate the field 24-36 hours after fertilizer application

Weed Control:

Interculture: Give two weedings one after 15 days of transplanting and the other after a fortnight. If paddy weeder is available, same can be used for this operation otherwise hand weeding may be done.

Chemical Weed Control

Weeds can effectively be controlled by applying herbicides.

1. Apply Butachlor granules 5 G @ 12 kg/acre 2-5 days after transplanting in standing water of 2-3 cm depth and don't drain the field for 4-5 days.
2. Apply Anilophos (30% EC) + Ethoxy sulfuron (10% EC) @ 500 ml + 60 ml/acre at 10 DAT.

It is beneficial to go for one hand weeding 15-20 days after herbicides application.

Harvesting: Harvest the crop when 80% of the grains in the panicle are of golden colour. Thresh the crop immediately after harvesting and dry the produce in shade for safe storage.

Plant Protection

The important pests and diseases which are generally found in Rice crop and their symptoms of attack along with control measures are given below:

I. Major Insect pest and their management

S.N.	Name of insect and symptoms	Insect Management
1.	**Root Weevil (*Echinocnemus oryzae*)**: It is a serious pest in low-lying water logged areas of R.S. Pura, Bishnah and Kathua blocks. The adults are ashy grey in colour. The grubs are white legless and feed on the roots up to 1 ½ months after transplanting. The attack appears in patches but sometimes whole field is involved. The attacked plants turn yellow, remain stunted and do not tiller. The pest is active from 15th June onwards.	Apply granular insecticides viz. cartap hydrochloride 4G 8 kg/acre in 5-7.5 cm deep standing water 2-3 days of transplanting and do not drain the water for 72 hours.
2.	**Thread Worms:** These are found clinging with root in the form of clusters Roots do not establish due to their constant movement and thus uptake of plant nutrients by the roots is restricted. The affected plants give sickly	1. Cartap hydrochloride 4 G @ 8 kg/ acre 2. Carbofuran 3G @10-12 kg/acre

	appearance, tillering is retarded and growth of plant is checked.	
3.	**Stem Borer (*Scriophaga innotata and S. incertulas*):** It is a minor pest of rice. The pale yellowish larva with orange head of this insect bore into the stems and cause damage. The affected young plants show dead hearts where as the old ones produce empty ear heads, which turn white and stand erect. The pest is active from July to September.	1. Install bird perches @ 8/acre. 2. Use pheromone traps @ 8/acre for mass trapping of the male moths. 3. Apply the following granular insecticides: Cartap hydrochloride 4G @ 8 kg/acre. Carbofuran 3G @ 10-12 kg/acre. Apply the granules in 5-7.5 cm standing water and do not drain or irrigate the fields for 72 hours of application. Spraying with cartap hydrochloride 50 SP @ 240 g/acre and be undertaken when there are 5% dead hearts or one egg mass/sq.m in case of stem borer.
4.	**Leaf Hoppers and Plant Hoppers:** These are main pests and cause considerable loss in all rice varieties. The adults of plant hoppers are green. These are active from early July to September. Both adults and nymphs suck cell sap from the leaves and thus plant loses vitality and gives a sick look. On their faces shooty mould grows due to which whole of the field look blighted. The insects are also vectors of many diseases.	1. Remove the weeds spp. viz., *Cynodon*, *Echinochloa*, *Eleusine* etc. growing in the vicinity of the field. 2. Install straw bundles in the field @ 1/kanal to conserve spider population. 3. Spray the crop with imidacloprid 17.8 SL @ 72 ml/acre or thiamethoxam 25 WG @ 60 g/acre in 240 L of water or acephate 75 WP @ 240 g/acre when 5-10 insects per hill up to mid-tillering and thereafter 20 insects/hill in case of leaf hopper and plant hoppers.
5.	**Rice Hispa (*Dicladispa armigera*):** It appears sporadically in all the varieties of rice irrespective of locality. The grubs of this pest mine into the leaves whereas adults are external feeders. The grubs cause damage by producing parallel white streak on leaves. The adults are small, shining oblong and bluish black in colour. It appears generally from beginning of August to September.	1. Avoid late planting of crop. 2. If attack of rice hispa (grub) is noticed in nursery stage, clip the affected tips of leaves before transplanting. 3. Spray the crop with acetamiprid 20 SP @ 24g/acre or 0.1 g/liter of water when there is one adult/grub or one damaged leaf/hill.
6.	**Grass Hopper:** Both adults and nymphs feed on leaf margins in an irregular fashion in the nursery as well as in the transplanted crop. They also cut developing ear heads. The pest is active from June to November.	1. Destroy eggs by scrapping the top soil bunds of field before monsoon. 2. Soil application of chlorpyriphos 1.5% D @ 10 kg/acre or cartap hydrochloride 4G @ 8 kg/acre or chlorpyriphos 20 EC @ 480 ml/acre 3. With the onset of monsoon, spray the bunds within the cultivable area

		with Malathion 5% D @ 10 kg/acre. Repeat the spray after 21 days on need basis.
7.	**Leaf Folder (*Cnaphalocrocis medinalis*):** The caterpillars feed on leaves and cut them to form tubular cases inside which they live and continue to feed, resulting in appearance of white streaks.	1. Use light traps @ 1/acre. 2. Use rope method to dislodge the larvae. 3. Spray betacyfluthrin 0.04% or chlorpyriphos 0.05% or spray the crop with acephate 75 WP @ 240g /acre or 1g/litre of water or chlorpyriphos 20 EC @ 480 ml/acre
8.	**Army Worms**: Greenish or dusky brown with pale & brown striped caterpillars on the leaves feed at night and rest during day. In severe infestation feeding may be noticed during day time also. It is a sporadic pest in hilly areas on rice and maize crops, caterpillars remain hidden in leaf whorls during day time.	Spray the crop with chlorpyriphos 20 EC @ 480 ml/acre or with acephate 75 WP @ 240g /acre or 1g/L of water and direct the spray nozzle into the whorls.

II. Major Diseases and their Management

Sl.No.	Name of disease and symptoms	Disease management
1.	**Brown Leaf-Spot:** (*Bipolaris oryzae*) Small necrotic spots surrounded by reddish brown circular margins appear on the leaves and grains.	Use healthy and disease free seeds for nursery raising. Seed treatment with copper oxychloride @ 3g/kg seed. Spray the crop with propiconazole @ 0.1% at the appearance of disease and repeat the spray depending upon the disease severity.
2.	**Bacterial Leaf Blight:** (*Xanthomonas oryzae* pv. *oryzae*) Greenish yellow stripes appear along the leaf margins and extend both length & breadth wise. The leaf starts drying from the tip, becomes white and in severe cases, dries up completely. In Jammu division, the disease is invariably noticed at the flowering stage.	On the appearance of disease, drain the field and irrigate with fresh water after four days. Avoid field to field irrigation and delay the application of urea. Soak the seeds for 12 hr in solution of streptocycline (2.5g) + copper oxychloride (25g) in 10L of water. Spray the crop with streptocycline (40g) + copper oxychloride (200 g) in 200 L of water at the appearance of disease.
3.	**Bacterial Leaf Streak:** (*Xanthomonas oryzae* pv. *oryzicola*) Small translucent streaks appear in the inter veinal areas of the leaf. The streaks gradually extend in size and turn reddish when plant is near maturity. In severe cases plants dry up	Follow the same control measures as in Bacterial Leaf Blight.

	and fields give a burnt appearance.	
4.	**Sheath Blight:** (*Rhizoctonia solani*) Disease appears at the maximum tillering stage and affects all plant parts above water line. Greenish grey irregular lesions, which look like snake skin from a distance, develop indefinitely on stem and sheath. Sclerotia are formed on the basal portion of the sheath, which are white when young and turn brown to dark brown later.	1. Use seeds from healthy and disease free crop. 2. Deep ploughing and use of limited but adequate fertilizers. 3. Avoid close planting and follow field sanitation. 4. Seed treatment with copper oxychloride @ 3g/kg seed. 5. Spray with tebuconazole @ 0.1% at the appearance of disease and at boot leaf stage. 6. Follow the crop rotation.
5.	**Sheath Rot:** (*Sarocladium oryzae*) The disease occurs on upper most leaf sheath enclosing young panicles. Lesions appear oblong to irregular with brown margins and grey centres or grayish brown. Lesions coalesce and whitish powdery growth may be seen in the affected sheaths.	Follow the same management measurement as in case of sheath blight.
6.	**False Smut:** (*Ustilaginoidea virens*) The disease so far not considered as a serious one, is gradually becoming severe one. In place of normal grains, mehndi coloured smut balls are formed under favourable conditions. Most of the high yielding varieties are attacked and the incidence varies from 5% to 20%.	Spray the crop with copper oxychloride @ 0.3% at 50% flowering stage.
7.	**Khaira Disease:** (Zinc deficiency) Bronze coloured irregular spots appear on the leaves. Disease mainly appears at 15 days after transplanting.	1. Apply 1.25 kg/kanal zinc sulphate in the soil. 2. Spray the crop with solution of 250 g zinc sulphate + 125 g lime in 40 litre of water.
8.	**Blast:** (*Pyricularia oryzae*) It causes eye shaped spots on the leaves before and after ear emergence. The spots are ashy coloured in the centre, surrounded by brownish margins. In severe cases leaves, leaf sheaths, neck and ear heads are also attacked causing considerable losses.	1. Use healthy and disease free seed for nursery raising and treat the seed with copper oxychloride @ 3 g/kg seed. 2. Spray the crop with tricyclazole @ 0.06% or azoxystrobin + difenoconazole @ 0.1%.

Important Hints for Maximizing Rice Yields

1. Select suitable variety to grow.
2. Use certified seed, free from weeds, pest and diseases.
3. Raise healthy seedlings, free from weeds, pest and diseases.
4. Transplant seedlings at 4 to 6 leaf stage and at proper time.
5. Always transplant 2 to 3 seedlings per hill.
6. Maintain proper plant population by maintaining proper spacing between plants. This is most important to get higher yields.
7. Gap filling may be done twice, once within 7-8 days of transplanting and second within 2nd week of transplanting if necessary.
8. Use recommended dose of manures and fertilizer.
9. Save the crop from insect, pest and diseases. Adopt timely plant protection measures.
10. Control weeds at proper time otherwise they will compete with crop plants and reduce production considerably.
11. Harvest at proper time. Over ripening will result in shattering of grains and thus reduce the yield.
12. To check lodging, lopping of the upper half of crop canopy (Basmati) after 45 DAT may be done.
13. Control weeds at proper time otherwise they will compete with crop plants and reduce production considerably.
14. Harvest at proper time. Over ripening will result in shattering of grains and thus reduce the yield.
15. To check lodging, lopping of the upper half of crop canopy (Basmati) after 45 DAT may be done.

1.1.3 Direct Seeded Rice

Direct seeded rice refers to the process of establishing a rice crop from seeds sown in the field rather than by transplanting seedlings from the nursery. Direct seeding avoids three basic operations, namely, puddling (a process where soil is compacted to reduce water seepage), transplanting and maintaining standing water. It has been observed from several years' experimentation at SKUAST-J that direct seeded rice under low land irrigated conditions, yields at par or even higher than transplanted rice. It saves labour, time, irrigation water and energy, since in this method the most cumbersome operations of puddling and transplanting are omitted and as such a large area can be put under rice cultivation in less time.

Soil: Except light soils, this practice is recommended for all types of soils. Light soils usually suffer from iron deficiency (4-6 weeks after germination and results in chlorosis). The iron deficiency can be corrected by repeated copious irrigations or with the application of 0.5 per cent ferrous sulphate solution at weekly intervals (1 kg of ferrous sulphate solution in 200 litres of water/acre).

Varieties:

S. No	Types of rice	Varieties
1	Coarse	SJR-5, Jaya, PR-113, K-39, China-1039
2	Semi-fine	Ratna
3	Fine	IET-1410, PC-19
4	Super-fine	Bamati-370, Bamsti-564, Ranbir Basmati, Jammu Basmati 129, Pusa Basmati 1121, Pusa 1612 and Pusa Basmati 1728

Agronomic Practices

Field Preparation: Precise levelling of the field is important to improve irrigation water management and to ensure uniform depth of rice seeds for good establishment and uniform germination. It is recommended that laser levelling should be done at least a month before sowing. After laser levelling, the field should be irrigated to identify uneven areas in the field which can be taken care of through fine levelling again. The irrigation also stimulates weeds and previous rice crop seeds to germinate, which can be killed before seeding of rice seeds. The land is tilled (summer ploughing) soon after the harvest of previous *Rabi* crop. Irrigate the field prior to sowing and give 2 to 3 harrowing when it comes to proper moisture conditions. This can also be achieved by ploughing the field 3 to 4 times with *desi* plough.

Time of sowing: Course and semi fine rice types which usually are of short durations may be sown from last week of May to first week of June. Fine rice types

(Basmati) which are often long in duration, can be sown between 2nd and 3rd week of June. Sowing time may also depend upon the area and the sowing of the succeeding crop to be taken in system with rice.

Seed rate: Under DSR with rice seeder, 8-10 kg seed for fine and 10- 12 kg for semi fine and coarse varieties of rice is sufficient for an acre of land. A higher seed rate of 12-14 kg/acre is used in DSR carried through seed drill, zero seed drill, *Kera* and broadcasting methods.

Seed treatment: Seeds are treated by soaking in water containing Bavistin and Streptocycline for 10-12 hours and are to be dried in shade before sowing. For treating 10 kg seed; a liquid formulation consisting of 10 lit. water + 20 gm Bavistin + 1 gm Streptocycline is required.

Method of Sowing: The choice of technique depends upon farm level conditions and resources available with farmers. The selection of technique is influenced by the time of sowing and inputs to be used in rice cultivation. Sowing should preferably be done in the evening hours at 20 cm row spacing at a depth of not more than 3 cm. This will help to improve germination.

DSR with Rice Seeder (DSRRS): Rice seeder is the ideal machine meant for direct seeding of rice. This machine maintains row to row distance as well as plant to plant distance within rows.

DSR through zero till seed drill/seed cum fertilizer drill: Zero seed drill or seed cum fertilizer drill recommended for sowing of wheat can also be used for direct seeding of rice after proper calibration under the guidance of technical persons and with certain modified procedures of sowing.

Direct dry seeding of rice through drum seeder: Direct dry seeding of rice can also be done through modified drum seeder recommended for sowing rice under puddled conditions with minor modifications in the drum seeder. The additional attachments fitted in the drum seeder are four shares for opening the furrows and a planker to cover the seeds placed in the furrows. It is beneficial for the farmers with small holdings and having labour scarcity.

DSR through *Kera* method: If no machinery is available, farmers can go for direct seeding of rice by *Kera* method by opening furrows using tractor or bullock drawn plough at a spacing of 20 cm in one direction only. The seeds should be sown in the furrows by *Kera* method. After sowing, the seeds in the furrows are to be covered by planking

DSR through broadcasting in opened furrows: As a last resort and under extreme compulsions broadcasting of seed in open furrows can also be done but with certain scientific procedures as under *Kera* method, provided that planking should be done in the direction perpendicular to the direction of the furrows in the field. This will help not only in proper coverage of the seed but shall also enable the seeds which are dropped on the ridges to get in to the furrows. May be put in to practice amid labour

scarcity situations only, that too, if all the other recommendations of DSR are strictly adhered to.

Fertilizer and Nutrient Management: The need of N, P and K varies in relation to variety and is applied accordingly.

S. No.	Variety	Nutrient Requirement (kg/acre)			Fertilizer Requirement (kg/acre)		
		N	P	K	Urea	DAP	MOP
1.	IET-1410 & K-39	20	12	8	33	26	13
2.	China-1039	15	12	8	25	26	13
3.	Ratna	32	16	8	56	35	13
4.	SJR 5/ PC-19	40	24	12	66	52	20
5	Jaya	40	24	12	66	52	20
6.	Basmati 370, Ranbir Basmati	12	8	4	20	17	6.4
7.	Pusa Basmati 1121, Pusa 1612, Pusa Basmati 1728, Jammu Basmati 129	18	10	6	30	22	10

1/3rd N, full P and K are applied as basal while remaining remaining 2/3 of nitrogen is to be applied in two equal splits between 40-45 DAS and 60-65 DAS depending upon the variety.

Irrigation Water Management:

Plan pre sowing irrigation keeping in view the soil type and current climatic conditions as the field should preferably contain sufficient moisture at the time of sowing.

First irrigation is to be applied at least five days after sowing and this duration can be extended up to 21 DAS depending upon the weather, soil and crop conditions. Thereafter, need based irrigation is to be applied by following the process of alternate wetting and drying.

Weed Control

The success of this method is directly related with the efficiency of weed control. Apply pendimethalin 400 ml/acre (Pre-emergence) followed by application of bispyribac-sodium @ 10-12 ml/acre when the crop attains the age of 25-30 DAS using 200 litres of water for each herbicide. At 45 days after sowing spot hand weeding may be done to remove the weeds which have escaped to these herbicides.

Harvesting

Direct seeded rice matures a week earlier than the transplanted crop. The crop should be harvested when 80% grains in the panicle are of golden colour. Thresh the crop immediately after harvesting and dry the produce in shade for safe storage.

Plant Protection: Same as mentioned under rice cultivation in subtropical areas.

Tips for Maximising Yield in Direct Seeded Rice

- Direct seeding of rice is the process of establishing the crop from seeds rather than by transplanting of seedlings. Direct seeding avoids three basic operations, namely, nursery raising, puddling and transplanting.
- Prepare the land with soil turning plough followed 2-3 harrowings and planking under optimum moisture (Vattar conditions).
- Seeds are sown 10- 15 days prior to onset of monsoon (5th June to 15th June)
- Use 30 kg/ha of seed for fine varieties and 40 kg/ha of seed for coarse varieties.
- Treat the seeds with azoxystrobin @ 2g/kg of seed or copper oxychloride @ 3 g/kg of seed.
- Seeds should be sown at specified spacing of 20 cm by seed cum fertilizer drill at a depth of 3-4 cm.
- Seed drill with inclined plate metering mechanism especially developed for direct seeded rice should be prepared for accurate depth control during seeding
- Weed Management: Apply pendimethalin 400 ml/acre (Pre-emergence) followed by application of bispyribac sodium @ 10-12 ml/acre when the crop attains the age of 25-30 DAS using 200 liters of water for each herbicide.

1.2 MAIZE

Maize is of special importance in hilly and sub-mountainous regions of Jammu Division where it forms staple diet of the people. It occupies highest area under cultivation in the state. Inspite of the fact that maize occupies major area during Kharif season, the gross yield is low. The low yield is due to use of recycled local seeds and traditional agronomical practices. Hybrids and composites are the high yielding varieties of maize, which have the potential to outyield the local varieties. Maize production can be enhanced by adopting improved cultivars/hybrids and following improved production techniques.

Climate: Maize requires considerable moisture and warmness from the beginning of sowing to the end of flowering. Extremely high temperature and low humidity during the flowering period dessiccate the pollen which interferes with proper pollination, leading to poor grain formation resulting in low grain yield.

Rainfall varying from 50 cm to 75 cm during vegetative growth period is conducive to the proper development of maize plant. Maize is very sensitive to water logging particularly during the early growth and at flowering stage. Maximum reduction in grain yield occurs when crop remains under moisture stress at flowering stage.

Soil: Maize can be grown on a variety of soils but it performs well on well drained fertile loams and silt loams. Select fertile, well drained and leveled fields for growing of hybrid/composite varieties of Maize.

Varieties:

Hybrids

1. **Ganga Safed 2 (GS-2):** This white grain hybrid is suitable for sub-tropical areas of Jammu Division where maize is preferred. It matures in 95-100 days.
2. **Vivek Maize Hybrid -25:** It is early maturing yellow grain single cross hybrid with medium plant height and ear placement. Its average yield realized is 18 q/acre under mid hills ecology.
3. **Vivek QPM-9:** It is early maturing quality protein single cross orange yellow hybrid with medium plant and ear height. The hybrid is suitable to be grown in isolated conditions (minimum 500 m) from other maize fields. The average grain yield realized 18 q/acre under mid hills ecology.
4. **HQPM-1:** It is a late maturing yellow grain quality single cross hybrid with average potential yield of 20q/acre. It is suitable to grow in isolated conditions (minimum 500 m) from other maize fields under irrigated conditions in sub-tropical plains.
5. **PHM-12:** It is a medium maturity yellow grain single cross hybrid with average grain yield potential of 18 to 20 q/acre for cultivation in mid hill ecology under irrigated conditions. It takes 130-135 days to maturity.

Composites

1. **Vijay:** This variety has semiflint yellow grains and is suitable for the areas, which fall between 600 m to 1350 m height. This variety can be rotated with other crops depending upon the altitude.
2. **C-6 (Shalimar):** Orange yellow flint variety, suitable for hilly areas which fall between 1050 m to 1800 m height. This variety can be rotated with early crop of oilseeds, barley or vegetable pea upto 1500 m height.
3. **C-2:** This is a yellow grained variety and is suitable for the hilly areas which fall between 1050 m to 1800 m height.
4. **Super Composite (Mansar):** It has orange flint grains with a yield potential of 20-24 q/acre. It is also recommended for mid elevation of Jammu.
5. **Composite (Trikuta):** It has orange flint grains with a yield potential of 20-24 q/acre. It is also recommended for mid elevation of Jammu.
6. **Composite C-8:** This variety has creamy white, bold, semiflint to semident grains variety having a yield potential of 18-20 q/acre. It is recommended for mid elevation of Jammu.
7. **Composite C-15 (Rehmat):** It is an early maturing composite suitable for higher elevations upto an altitude of 2250 m. It has yellow dent, semident grains and a yield potential of 20-24 q/acre.
8. **JMC-**3: This is yellow grain variety and suitable for hilly areas. It is medium maturity variety which matures in 130 to 133 days and yield potential of 18 to 20q /acre.

Note:

1. Always sow fresh and certified seed of hybrid/composite maize.
2. Purchase hybrid maize seed every year.
3. Seeds of composite varieties can be used for 2-3 years. If the seed is selected from the previous crop, carefully, select 3000 to 5000 cobs from the central portion of the field leaving 9 m all round and keep desired quantity of seed for next year sowing obtained from the mixed lot or the selected cobs.

Agronomic Practices:

Land Preparation: To achieve the desired tilth, plough the land with Tawi plough (soil turning plough) and subsequently with disc harrow or traphali or soil stirring plough 3 to 4 times. Each ploughing should be followed by planking to ensure fine tilth and conservation of moisture.

Seed Rate: For Plain Areas Use 8 kg of seed/acre for line sown crop. In case of broadcast sowing, use 12 kg of seed/acre. For **Hilly Areas** Use 14-16 kg seed/acre

Seed Treatment: To avoid diseases ensure seed treatment before sowing. Seed treatment also helps in better germination. Before sowing, treat the seed with copper oxychloride @ 3 g per kg of seed. Where head smut is a problem, treat the seed with carboxin W.P. at 2.5 g per kg of seed.

Time of Sowing:

Sl. No.	Variety	Area of adoption	Date of sowing
1.	GS-2	Irrigated plains	1st fortnight of June
	C-8, C-5, Mansar	Unirrigated plains	With the onset of monsoon, but in no case of sowing be extended beyond 10th July.
2.	GS-2, Mansar, Vijay, C-5, C-8	Intermediate	With the onset of monsoon, but in no case sowing should be extended beyond 30th June. GS-2 can be sown upto 600 m altitude only.
3.	Mansar, C-2, C-6, Vijay, C-15	Temperate	Upto 1500 m, sowing can be done from April to 15th May. And above 1500 m, it should be done in the month of April only. Vijay is recommended upto 1350 m. Sowing with local tall maize should be done in the month of April. C-15 is recommended upto an altitude of 2250 m.

Method of Sowing: Maize being a rainy season crop, there is every chance of more weeds and therefore to facilitate weeding and inter culture operations, it should be sown in lines 75 cm part in case of hybrid maize and at 60 cm apart in case of composite maize. The distance 20 cm from plant to plant may be kept, which will provide the desired plant population for higher production.

Sowing may be done with a seed drill or maize ridger (Tractor driven or Bullock drawn or manually operated or behind the plough) to a depth of 3-5 cm. In case of broadcasting, broadcast the seed uniformly in the entire area so that uniform plant population may be achieved. Maize can also be grown mixed with Rajmash

Intercropping: Following maize + pulse intercropping systems with one row of pulse in between two rows of maize are recommended for Subtropical and Intermediate zone of Jammu region. i) Maize + Moong, ii) Maize + Mash iii) Maize + Cowpea(Use recommended seed rate for maize and 1/3rd of the recommended seed rate for pulses).

Planting two rows of cowpea as intercrop in paired rows of maize in additive series wherein maize is sown at row to row distance of 60 cm and cowpea at row to row distance of 20 cm without compromising the number of rows of maize crop is recommended to attain higher productivity in maize based intercropping system under rainfed conditions.

Intercropping of one row of rajmash in between two rows of maize sown at its proper crop geometry is recommended for

Fertilizers and Nutrient Management:

1. Apply 60q/acre of well rotten FYM or compost & incorporate into the soil thoroughly with the first plough.
2. In addition to FYM/Compost application, balanced application of chemical fertilizers is also necessary. For balanced fertilizer, application the soil should be got tested prior to sowing of the crops.
3. However, in general, for average fertility conditions, the following dose of chemical fertilizers is recommended. If 60 quintals/acre of FYM/Compost is added, reduce the quantity of below noted nutrients by 25%.

Sl. No.	Nutrients requirement (kg/acre)				
	Area	N	P	K	Zinc Sulphate ($ZnSO_4$)
1.	Irrigated plain areas	36	24	12	10
2.	Unirrigated plain areas and hilly areas	24	16	8	3

The above mentioned plant nutrients can be obtained from the following fertilizer combination:

Sl. No.	Fertilizer (kg/acre)				
	Area	Urea	DAP	MOP	Zinc Sulphate ($ZnSO_4$)
1.	Irrigated plain areas	58	53	20	10
2.	Unirrigated plain areas	40	36	13	3

NOTE: Zinc Sulphate should at least be applied once in three years.

Fertilizer Application

a) Drill entire quantity of P and K along with Zinc Sulphate and 1/3rd N at the time of sowing with pora as basal dose.
b) Remaining quantity of nitrogen may be applied as top dressing in two equal splits - 1st when the plants are knee high stage i.e. a month after sowing and 2nd before tassel formation i.e. about two months after sowing.

Application of Single Super Phosphate (SSP) at 140 kg/acre gives equally good results as in the case of DAP besides supplying the Sulphur to the soil.

Zn deficiency**:** Zn deficiency is widely noticed in areas where the high yielding varieties are grown especially in irrigated areas. The deficiency symptoms are clearly noticed within two weeks of seedlings emergence. A broad band of very light yellow tissue or band of white tissue, with reddish veins appears, on the side of the midrib, beginning at the base of the 2nd or 3rd leaf from the top of the plant. The white patch later extends in strips towards the tip parallel to the midrib. However, midrib and the leaf margin remain same.

The plants remain stunted and have short internodes. White stripes appear in the upper leaves in case of mild deficiency. Mild deficiency symptoms disappear by the mid-season but the two stages viz., silking and tasseling are delayed. Broadcast 10 kg of $ZnSO_4$ Heptahydrate (21%) per acre in the field where the deficiency symptoms appears in the preceding crops. Apply 6 kg /acre $ZnSO_4$ Monohydrate (33%) per

hectare at sowing mixed with an equal quantity soil, along rows, hoe it in to the soil and then irrigate the field. When the symptoms are observed late in the season and interculture is not possible, spray $ZnSO_4$- lime mixture prepared by mixing 480g of $ZnSO_4$ (21%) and 240g of unslaked lime or 300g $ZnSO_4$ Monohydrate(33%) and 150g of unslaked lime with 200 L of water to cover one acre of land.

NOTE: Top dressing of urea should always be done in the afternoon hours when foliage is dry otherwise urea will burn the foliage.

Application of integrated use of inorganic and organic fertilizers, i.e., FYM @4 t/acre + 16 kg N /acre (urea) with recommended dosage of phosphorus and potassium is recommended in Maize under Rainfed conditions.

Weed Control

(i) Cultural Practices: Maize crop should be kept free of weeds upto 40 days after sowing, otherwise yield is considerably reduced. Two hand weedings done at 15 and 30 DAS or weeds within the rows can be effectively controlled by using traphali or 5 tinned hoes. This can be done with khurpa or hand blade hoe too. The crop should also be earthened up with bullock drawn ridger or with a spade when the crop is at knee high stage (after one month of sowing).

Note: No inter culture should be done after 6 weeks of sowing since this would lead to pruning of fine roots and finally reduce the production.

(ii) **Chemical Method:** Atrazine 50 EC herbicide @ 400 g/acre in 200 L of water should be sprayed on soil surface within 2-3 DAS as pre-emergence application to control weeds in the sole crop of maize.

Irrigation Water Management: Maize is a rainy season crop and does not withstand water logging hence arrangements for drainage of excess water from the maize field should always be made at the time of sowing. This can be done by providing shallow surface drains at suitable intervals and main drainage channel.

For irrigated crop, irrigate the field 5 to 7 days earlier to sowing and when soil comes to proper optimum moisture conditions sow the seed.

Irrigate the crop as and when necessary never allow the crop to suffer from water stress condition. Moisture stress at flowering and at grain formation stages reduces the yield, tremendously. Hence, irrigate the crop at these stages if there is no rain water available.

Never allow water to stand in the field for more than 3 hours.

Harvesting: The hybrid and composite maize plants remain green even when the crop is ready for harvest. When husk cover over the cobs dries and turns brown and grain hardens, the crop should be harvested. Harvesting time varies as different varieties have different maturity groups. The grains from dried cobs should be shelled with traditional methods or with hand corn-sheller and dried in sun for safe storage.

Plant Protection

I. Insect Pest and their Management

Sl. No.	Name of insect and symptoms of attack	Control measures
1.	**Maize Cut Worm (*Agrotis spp.)*** This is dark brown, a serious pest of maize in hilly areas. Caterpillars after emergence of crop are external feeders for few days but there after they get entry into the soil and assume the habit of cutting. Losses to the crop are caused by cutting the plants in the initial stage at the surface level. Caterpillar cuts more number of plants than it actually consumes and thus losses are very heavy. Adults are black in colour with grey spots on the wings.	1. Regular raking the field will help to reduce pest attack. 2. Install light traps @ 2/acre for mass collection and destruction. 3. Install pheromone traps @ 6/acre to attract and kill male moths. 4. Prophylactic measures as indicated below, should be under taken to control maize cut worm before sowing. Mix of chlorpyriphos 1.5% D @ 10 kg/acre in the soil with the last ploughing. Where soil application could not be given spray the crop with chlorpyriphos 20 EC @ 480 ml/acre. Spraying should be direct on the soil surface.
2.	**Maize Stem Borer *(Chilo partellus*)** This is also a very serious post of maize crop. The larvae first scrape the leaves and then bore into stem through the leaf whorl or leaf sheath. Central shoots of the attacked plants get perforated. In young plants, the growing point is killed and a dead heart is caused. The adults are yellowish brown in colour.	1. Uproot the stubbles of previous year's crop and burn. Spray the crop with methyl demeton 25 E.C. @ 1 ml/litre of water or 240 ml/acre, cypermethrin 10 EC @ 1ml/litre of water or 240 ml/acre 2. Apply granular insecticides to control stem borer, viz cartap hydrochloride 4 G @ 8 kg/acre. The granules can be applied with small perforated tins directly into the whorls.
3.	**Army Worms:** This pest is prevalent in hilly region of the Jammu division. The caterpillar feed on the leaves at night and rest in whorls during day. In case of severe infestation feeding may be observed during day also.	1. Collection and destruction of moths by using any light device (Lantern, electric bulb etc.) by placing trays containing kerosene + water (1:3) below light source. 2. By digging 6" X 9" deep trench around the infested field and killing there in morning hours mechanically. Or By placing grass on the bunds and hidden caterpillar be killed as mentioned above. 3. Spray the crop with chlorpyriphos 20 EC @ 480 ml/acre or acetamiprid 20SP @ 0.2 g/litre of water.
4.	**Blister Beetle:** The adults feed on the silk of the cobs and affect the pollination. In initial stage the beetle feeds on the leaves also. As many as 8-	1. Spray the crop with acetamiptide 20 SP @ 0.2 g/litre of water at tasselling stage or chlorpyriphos 20 EC @ 480 ml/acre. Since plant height at this stage is maximum, spray

	10 beetles have been observed per plant. These are most destructive in temperate region of the division but have also been observed causing damage in sub-tropical areas.	should preferably be done with foot or rocking spray pumps. 2. Raising 1 to 2 rows of trap crop like okra, sunkukera or arhar around the field and destruction of beetles be done mechanically.
5.	**Aphids:** Aphids attack is serious on all high-yielding varieties of maize. It appears at the tasselling stage and sucks the sap from the tassels. In case of high build up of population, whole pollen grains are covered or plant loses its vitality.	Spray the crop with Dimethoate 30 EC @ 1-2ml/litre of water or imidacloprid @ 0.3 ml/litre of water or methyl demeton 25 EC @ 1ml/litre of water.
6.	**Hairy Caterpillars:** Caterpillars feed on the leaves or in case of severe infestation whole leaf blade is consumed and plant is reduced to mere skeleton. It also feeds on silk and milky grains.	Spray the crop with chlorpyriphos 20 EC @ 2ml/litre of water (480 ml/acre) or quinalphos 25EC @ 2ml/litre of water (480 ml/acre).
7.	**Maize Jassids:** It is a serious pest of maize in temperate region particularly in Doda district. The nymphs and adults suck the cell sap from the leaves as result the leaves turn papery and finally dry up.	Spray with Dimethoate 30 EC @ 1ml/litre of water or chlorpyriphos 20 EC @ 480 ml/acre.
8.	**White Grub:** Adults feed on leaves. Grubs feed on roots, thus up take of nutrients is reduced.	Use Chlorpyriphos 1.5 D @ 10kg/acre or cartap hyrdochloride 4G @ 8 kg/acre

II. Diseases and their Management

1.	**Head Smut** (*Sphacelotheca reiliana*): The whole cob (ears and tassels) is replaced with smut sori filled with black teliospores. Infected plant may develop symptoms either on ear or on tassel, including the production of wire like extension of vascular bundles in the tassels.	1. Field sanitation 2. Crop rotation for 2-3 years. 3. Uproot the affected plants and destroy. 4. Treat the seed with carboxim @ 2 g/kg of seed.
2.	**Common Smut** (*Ustilago maydis*): Produces galls on the ears, axillary buds, tassels, stalks and more rarely on leaves. Galls are dull white in colour and on rupturing expose the black powdery mass of spores.	1. Treat the seed with carboxim @ 2 g/kg of seed.
3.	**Stalk Rot** (*Erwinia chrysanthemi* pv. zeal): The fields affected with the disease emit a typical vinegar (sirka) smell. The diseased plants topple down from the affected spots.	Uproot the affected plants. Drenching near the collar region with copper oxychloride 3g/litre of water or apply bleaching powder @ 10 kg/acre.

4.	**Leaf Blight** (*Excerohilum turcicum* and *Bipolaris maydis*): Long elliptical greenish brown lesions appear on leaves. Affected leaves are thin and semi-transparent. Diseased plants look burnt.	1. Clean cultivation always helps in reducing the disease incidence. 2. Spray the crop with propiconazole @ 0.1% at the appearance of disease.

Important Hints for Maximizing Maize Yields

1. Always purchase fresh certified seed of hybrid Maize.
2. Provide proper water drainage system in maize.
3. Sow maize in lines for efficient weeding, interculture operations and provide a weed free environment in maize fields.
4. Apply recommended doses of fertilizers at proper time and in proper splits.
5. Save the crop from insect pest and diseases by adopting timely plant protection measures.
6. Under dry land conditions special measures can be taken for increasing the yield.

i) For achieving the optimum plant population in crust prone areas, amendments like *Athatoda vasica* (Branker leaves), FYM, Cowpea straw of 1 cm thick layers may be used on the sown rows.

ii) Conserve soil moisture by laying mulches

iii) Use foliar application of urea (3%) during dry spells.

1.3 BAJRA (PEARL MILLET)

Bajra has a special importance in un-irrigated plain areas of Jammu and Kathua districts. The yield of the crop is low because of local seed and traditional cultivation practices. Bajra yield can be increased if improved method of cultivation is followed. Hybrid seed of bajra is available which has the potential to out yield common local varieties manifold in grain yields as well as fodder. Follow the following cultivation practices to boost the bajra yield.

Soil and Climate: Bajra grows well in dry and warm climatic conditions and it is drought tolerant crop which requires low annual rainfall ranging between 40 cm to 60 cm. It can be grown in a wide range of soils. However it thrives but does best in well sandy loam soils having good drainage as it is highly sensitive to water logging. Moist weather is advantageous during its vegetative stage. However, the rainfall at the flowering stage is very harmful.

Varieties:

I. Composite/Synthetic

WCC-75: It possesses medium size seeds of light gray color, highly resistant to downy mildew and not normally susceptible to ergot or smut. It matures in 80- 85 days and its grain yield potential is 8q/acre.

ICMS-7703: It is medium tall with 3-5 tillers, compact cylindrical earheads, short and straw colored glumes. It matures in 85-90 days.

II. Hybrid:

MHB-110: It is medium tall, loose and thick conical earheads with long bristles. The grains are bold and shining grey. It matures in 85 -87 days.

MH-179: It is late maturing single-cross hybrid having long panicles. The variety has low tillering potential, thick stems, medium grain size and medium-tall plant height. It matures in 85 -90 days.

Nandi-65: This Hybrid is very good in grain & fodder yield and resistant to downy mildew and tolerant to lodging. It matures in 75-80 days.

Agronomic Practices:

Sowing Time: The crop is sown with the onset of monsoon. There should be enough moisture for seed germination.

Seed Rate: Use 2 kg of seed/acre. Always use treated seed. Treat the seed with copper oxychloride @ 3 g/kg seed. Always purchase fresh seeds of hybrid bajra every year.

Method of Sowing: 2-3 harrowings followed by ploughing is required to make fine tilth the soil in the field. Ensure enough moisture in soil for proper seed germination. Sow the seed about 2 to 3 cm deep in rows, 45 cm apart by kera method. Three weeks after sowing thin the seedlings so that plants are spaced 15 cm apart in the rows.

Gaps may be filled by transplanting the seedlings (obtained by thinning the crop).

Manures and Fertilizers: The soil may be got tested and accordingly as per the test results, the fertilizers are applied to the crop. In absence of soil tests, following fertilizer schedule may be adopted. These nutrients can be had from the following fertilizer combination:

Nutrient requirement (kg/acre)			Fertilizer (kg/acre)		
N	**P**	**K**	**Urea**	**DAP**	**MOP**
40	24	10	67	52	17

Entire quantity of P&K; and half of N may be applied as basal dose at the time of sowing or before sowing. The remaining half of N may be top dressed in two spilt dosages-1st at 30 DAS and 2nd at before head formation under sufficient soil moisture condition.

Application of 75% N (through Inorganic) + 25% N (through vermicompost) is recommended to attain higher grain yield of bajra under rainfed conditions.

Interculture: Keep the field free from weeds. Interculture to a depth of 5 cm but not too near the plants to avoid damage to the roots. Interculture the crop 3 to 5 weeks of sowing with hand blade hoe or khurpa. Earth up the plants with bullock drawn ridger if the crop is sown in lines otherwise use spade for this operation.

Irrigation Water Management: The field should be properly drained as water stagnation will damage the crop. Provide shallow drains at suitable intervals for draining out the excess water from the field. If irrigation is available, irrigate the crop at maximum tillering, flowering and grain setting stages as these stages are most critical for moisture stress.

Harvesting: Harvest the crop when grains are hard enough having 20% moisture. There are two ways of harvesting either cut the entire plant or remove the earheads first and then cut the plants later on. The ear heads should be properly sun dried and then heaped before threshing. The grains should be separated from the earheads by beating the heaps with sticks or by other means like trampling by bullocks. The threshed grains should be cleaned and dried well in the sun to bring down their moisture content to 12-14% for storage.

Plant Protection

I. Major Insect Pests and their Management

Leaf Eating Caterpillars & Grass Hopper: To control the leaf eating caterpillars and grass hoppers which appear periodically, dust the crop with chlorpyriphos 1.5% D @ 10 kg/acre.

Weevils: The grey weevil which is a serious pest of cotton also shifts to this crop and causes serious damage. It can be controlled by spraying malathion 50 EC @ 2 ml/litre of water or 480 ml/acre

Blister Beetle: Blister beetle and stem borer also attack the bajra crop. Adopt the same control measures as recommended to control these pests in case of maize crop.

II.Major Diseases and their Management

Name of the disease and symptoms of attack	Control Measures
Green Ear Disease or Downy Mildew: (*Sclerospora graminicola*) The leaves of infected plants show discoloration, yellowing. Under humid conditions, the leaves are covered with downy white growth of the fungus, which is prominent on the lower surface. The leaves turn necrotic and there is shredding. Ears of the infected plants are transformed wholly or partly into green heads of small, twisted leafy structures	1. Rogue out the diseased plants early in the season to prevent secondary infection. 2. The diseased ears should be collected and destroyed by burning. 3. Treat the seed with metalaxyl @ 2g/kg of seed. 4. Follow 3 to 4 years rotation with non host crop. 5. Grow resistant varieties. 6. Spray the crop with metalaxyl @ 0.1% after 30-35 days of seed germination.
Ergot: (*Claviceps microcephala*) At blossoming pinkish or light coloured fluid (honey dew) exudes from spikelets on different parts of the ear. Later dark sticky patches appear on the ear. After fertilization, small dark brown sclerotia appear in place of grains in the glumes. Seed set is poor or is completely inhibited. The ovary is replaced by a fungal mass with many folds on the surface. Ergot plants should not be fed to the cattle as it contains ergotoxine, which is quite harmful for cattle.	1. Early sowing) escapes the disease incidence. Follow two year crop rotation. 2. Dip the seeds before sowing in 10% salt solution and remove the floating sclerotia. 3. Seed treatment with copper oxychloride @3g/kg of seed or carboxin @2g/kg of seed. 4. Spray the crop at boot leaf stage with copper oxychloride @3g/litre of water. 5. Ergot infected ears with honeydew should be rogued out and destroyed by burning.
Smut: (*Tolyposporium penicillarial*) Only scattered grains (single or in groups) in the ear are infected. The diseased grains are converted into deep brown to black spore mass of the fungus. The smut sori are oval or pear shaped.	1. Seed treatment with carboxin @ 2 g/kg of seed. 2. Use certified seed and follow two to three year crop rotation.

Important Hints for Maximizing Bajra Yields

1. Purchase fresh seed of hybrid bajra every year.
2. Treat the seed before sowing.
3. Sow the crop in time.
4. Sow the crop in lines and keep proper distance between plants.
5. Sow the seed at proper depth under optimum soil moisture conditions for good germination.
6. Apply the recommended dose of fertilizers.
7. Keep the crop free from weeds.
8. Fill the gaps to ensure proper plant population.
9. Keep the crop free from pests and diseases.
10. Harvest the crop at proper stage.

1.4 HYBRID JOWAR

Hybrid Jowar can offer high yields under rainfed conditions. It is suited for *Kandi* belts of Jammu division.

Soil: Jowar can be grown on all types of soils but heavy soils are most suitable. Adequate drainage should be provided.

Varieties:

CSH-6: This variety matures in 90-100 days and having grain yield potential of 20-24q/acre.

CSH-9: This variety requires 110-115 days for maturity and has grain yield potential of 18-20q/ha.

Agronomic Practices:

Land Preparation: Select a uniform and well levelled land with good drainage. Plough the field 15 cm deep with Tawi plough. Obtain a good tilth by 3-4 subsequent ploughing with Desi plough or Disc harrow, followed by planking. Apply 60 q/acre FYM or well rotten compost before the last ploughing. Ensure optimum moisture in the soil for seed germination. If white ants and white grubs are a problem, apply chlordane 10% dust @ 1.25 kg/kanal in the soil at the time of land preparation.

Sowing Time: The crop should be sown with the first break of monsoon rains.

Seed Rate and Sowing: Use 5 kg of seed per acre. Always sow fresh, healthy certified seed. If the seed is not treated, treat the seed with copper oxychloride or carboxin @2 g/kg of seed. Drill the seed not more than 4 cm deep in rows, 45 cm apart. Immediately after germination, fill up the gaps if any by hand dibbling. Thin out the seedlings 3-4 weeks after germination in order to maintain plant to plant spacing of 10 to 15 cm

Manures and Fertilizers: Apply the chemical fertilizers as per soil test result. However, in absence of soil test results, following schedule of fertilizer is recommended. In case, 60q of FYM/compost is added per acre, reduce the following fertilizers by 25%. These nutrients can be had from the following fertilizer combination:

Nutrient requirement (kg/acre)			Fertilizer (kg/acre)		
N	**P**	**K**	**Urea**	**DAP**	**MOP**
20	12	06	33	26	10

Apply whole quantity of phosphorus, potassium and half the quantity of nitrogen as basal dose. The remaining half of the nitrogen may be top dressed between 30 to 40 days after sowing i.e. when the plants attain the height of 30 cm and coinciding with rainfall.

Interculture: Keep the crop free from weeds. Give shallow interculture not more than 4 to 5 cm deep with khurpa, hand blade hoe or bullock drawn traphali can be used for interculture operation.

Harvesting: The crop should be harvested when grains become hard having less than 25 % moisture. Harvesting should be done immediately after it is mature and do not wait for stalks and leaves to dry up as the hybrid varieties have stay green trait even after the crop is mature. Most of the high yielding sorghum hybrids take 100 to 115 days to mature. Harvesting is done by cutting the entire plant or removing the earheads first and cutting the plants later on. In areas where, there is danger of rains at the time of harvesting, the ear heads should be removed first and the cut the plants and heaped later on.

Threshing should be done with the help of thresher or by beating earheads with stick or trampling by the bullocks. The threshed grains should be cleaned and dried well in the sun for about a week to bring down the moisture content to 13-15% for safe storage.

Yield: With the recommended cultivation practices, it is possible to harvest 12 to 15 q of grain and about 40 to 50 q of dry stover from one acre of land.

Plant Protection

Major Insect pest and Their Management

Shoot Fly and Stem Borer: Shoot fly is very serious in initial stage of plant growth and cause dead hearts. Stem borer appears after shoot fly attacks and also causes dead hearts. To control these insects, apply cartap hydrochloride 4G granules @ 8 kg/acre in the central whorls 10-20 days of sowing.

Leaf Defoliators, Caterpillars, Weevils, Beetles and Ear Head Bug: They feed on all the plant parts. Spray the crop with acetamiprid 20SP @ 0.2 g/litre of water or 48g/acre in 240 litre of water.

Aphids and Jassids: These suck the sap of the plants and make the plants very weak. Spray the crop with methyl demeton 25 EC @ 1 ml/litre or dimethoate 30 EC @ 1-2 ml/litre of water.

1.5 LESSER MILLETS

Lesser millets or small millets- a group comprises of six crops viz. Finger millet, kodo millet, little millet, foxtail millet, barnyard millet and proso millet are considered as nutri-cereals and are a source of food, feed and fodder. Lesser millets are more nutritious than fine cereals. The name small or lesser millets are based on its small grain size. These crops have traditionally been the indispensable component of dry farming system in India. These millets are mostly grown in the rainfed areas of Kishtwar and Doda districts of Jammu province.

1.5.1 SALAN

Salan is cultivated in low rainfall areas of Doda district in marginal soils. It is commonly called (Shole). It is a drought resistant lesser millet.

Varieties: There are no standard varieties. However, Padder local is high yielding type.

Agronomic Practices

Land Preparation: The land should be prepared by giving 2-3 ploughings/ followed by planking. Ensure good moisture conservation to obtain uniform germination and good stand.

Sowing Time: The optimum time for sowing of salan is the month of May.

Seed Rate and Method of Sowing: Use 8 kg seed/acre. The crop should be sown 2-3 cm deep in rows spaced 30 cm apart.

Fertlizers and Nutrient Management : Apply the chemical fertilizers as per soil test. However, in the absence of such a test, the following doses are recommended per hectare.

Nutrient (kg/acre)			Fertilizer (kg/acre)		
N	**P**	**K**	**Urea**	**DAP**	**MOP**
12	12	-	16	26	-

Apply 2/3rd N and full P as a basal dose by placement method. The remaining N be applied after one month of sowing or as the showers are received, but before flowering depending upon the availability of moisture.

Interculture: Keep the fields free from weeds especially during the first 45 days after sowing. The weeding may be done with hand hoes or other interculture implements.

PLANT PROTECTION

Major Insect Pest and their Management

Sl.No.	Name of insect and symptoms of attack	Control measures
1.	**Ants:** They carry away the seed after sowing.	Apply chlorpyriphos 1.5% D @ 10 kg/acre before sowing.

1.5.2 KANGNI (Foxtail Millet)

Kangni is mostly cultivated in rain-fed areas of Kishtwar and Paddar in Doda district. Locally it is known as 'ping' and a drought resistant lesser millet. The yield of the millet is low because of lack of improved technology. The following practices can boost its yield.

Soil and Climate: Foxtail millet is cultivated in tropical as well as temperate regions. The crop can be grown even at an altitude of 2000 metres. It require moderate temperature throught its life cycle. The crop can be grown successfully in areas receiving 50-75cm annual rainfall. It requires fairly fertile soil for good yields, although it can grow in poor soils. However, it thrives best on rich, well drained loam soils.They will not tolerate water logged soils or extreme drought.

Varieties: No standard varieties are yet available. However, white type Kangni cultivated in padder area has a good yield potential.

Agronomic Practices

Land Preparation: The land should be prepared by giving 2-3 ploughings, followed by planking. Ensure good moisture conservation to obtain a uniform germination and good stand.

Sowing Time: May is the optimum time for its sowing. Sowing by the middle to 3rd week of May is desirable.

Seed Rate and Method of Sowing: Use 8 kg seed per acre. The crop should be sown 2-3 cm deep in rows spaced 30 cm apart.

Fertilizers and Nutrient Management: Apply the chemical fertilizers as per soil test. However, in its absence, the following recommendations be followed.

Nutrient (kg/acre)			Fertilizer (kg/acre)		
N	**P_2O_5**	**K_2O**	**Urea**	**DAP**	**MOP**
12	12	-	16	26	-

Apply 2/3rd nitrogen and full phosphorus as basal dose by placement and remaining after one month of sowing or when rains are received but before flowering depending upon the moisture availability

Interculture: Keep the fields free from weeds especially during the first forty five days after sowing. Hand weeding may be done with hoes or other interculture implements available.

Harvesting: The crop can be harvested for fodder purpose or hay after 70-75 days of sowing depending on the variety. In case of seed production, the crop should be harvested 90-95 DAS**.**

Yield: The yield of kangni crop depends on the variety, soil type, climatic and other management practices. With improved package of practices the crop yields about 50-80q/acre of green fodder or 10-14q/acre of hay. For seed production, the crop yields about 3.5-4.0q/acre of grain.

Plant Protection

Major Insect Pest & their Management

S.No.	Name of insect and symptoms of attack	Control measures
1.	**Ants:** They carry away the seed after sowing.	Apply chlorpyriphos 1.5% D @ 10 kg/acre before sowing.

1.5.3 CHEENA (Proso millet)

Cheena is an early maturing lesser millet and cultivated in rainfed areas of Doda district. It can also be sown as a midterm correction where main crop of maize fails due to cutworms or severe drought early in the season. Grains of cheena are used in different ways as cooked grains, flour for making chapaties, parched grain etc. It can also be used in making kheer. Cheena makes poultry feed and its straw is a good quality fodder. Cheena has high protein content of 12.5%. It is also rich in lycine, amino acids containing 4.6% of protein. Besides it also contain 68.9% carbohydrates, 2.2% crude fiber and 3.4% ash.

Soil: It is generally cultivated on marginal soils.

Varieties: No standard varieties are available. However, Red Cheena is a high yielding type and matures early.

Agronomic Practices

Land Preparation: The land should be well prepared by giving 2-3 ploughings followed by planking. Ensure good moisture conservation to get uniform germination and good cropstand.

Sowing Time: June and July months are the optimum time for its sowing.

Seed Rate and Method of Sowing: Use 8 kg seed per acre. The crop should be sown 2-3 cm deep in rows spaced 30 cm apart.

Fertilizers and Nutrient Management: Apply the chemical fertilizers as per soil test. However, in its absence, apply the following schedule of fertilizers:

Nutrient (kg/acre)			Fertilizer (kg/acre)		
N	**P**	**K**	**Urea**	**DAP**	**MOP**
12	12	-	16	26	-

Apply 2/3rd of nitrogen and full quantity of phosphatic fertilizer as a basal dose by placement. The remaining nitrogen should be applied after one month of sowing but before flowering, depending upon availability of moisture.

Interculture: Keep the fields free from weeds. Give at least one hand weeding within one month after germinations. The weeding may be done with hand hoe or other interculture implements.

Harvesting: Cheena is a short duration crop and is ready to harvest 60 to 75 days

after sowing. The seeds in the tips of upper heads ripe and shatter before the lower seeds and later panicles get mature. The crop should be harvested when two thirds of seeds are ripe. The crop is threshed with hand or by trampling with bullocks.

Yield: With improved cultivation practices it is possible to harvest 8 to 10 quintals of grain and about 20 to 24 quintals of straw from one acre of land.

PLANT PROTECTION:

I.Major Insect Pest and Their Management

S.No.	Name of insect and symptoms of attack	Control measures
1.	**Ants:** They carry away the seed after sowing.	Apply chlorpyriphos 1.5% D @ 10 kg/acre or cartap hydrochloride 4G @ 8 kg/acre before sowing.
2.	**Top Shoot Borer:** It attacks cheena resulting in unfilled grains and sterile panicle	Spray chlorpyriphos 20 EC @ 1-2 ml/litre of water or cypermethrin 10 EC @ 1 ml/litre of water.

II. Major Diseases and their Management

S.No.	Name of insect and symptoms	Control measures
1.	**Head Smut:** The panicle bears a black sooty mass in place of grains.	The infected plants should be collected from the standing field and burnt. Seed treatment with carboxin @ 2g/kg seed.

2. OIL SEED CROPS

2.1 SESAMUM (TIL)

It is an important crop for dry land belt of Jammu province and generally grown under rainfed conditions.

Soil: Well drained sandy loam soils are best suited for its cultivation.

Varieties:

Punjab Til - 1: It is an early maturing variety. Seeds are bold and white in colour and contain 50% oil. It matures in 80-85 days.It yields about 200 kg/acre.

Agronomic Practices

Land Preparation: The crop requires well prepared seedbed. To get the desired tilth, the land may be ploughed with Tawi plough followed by 2-3 ploughings with disc harrow or *desi* plough. Each ploughing may be followed by planking and there should be enough moisture in the soil for seed germination.

Seed Rate and Sowing: Use 800g to 1 kg of seed per acre. The seed being very small, mix it with sand to ensure even distribution. The crop is mostly sown in 1st week of July or with the onset of monsoon. The crop should be sown 2-3 cm deep in rows spaced 30 cm apart Maintain plant distance of 15 cm by thinning the plants after germination. Do not sow the seed deeper than 4 to 5 cm in the soil.

Manures and Fertilizers: Apply 2q/acre of well rotten FYM/compost and incorporate it well into the soil with the last ploughing. In light soil of low fertility, the following plant nutrients may also be applied:

Nutrient (kg/acre)			Fertilizer (kg/acre)		
N	**P**	**K**	**Urea**	**DAP**	**MOP**
8	4	-	14	9	-

Drill whole quantity of Urea and DAP before sowing in the field. Avoid excessive fertilizer application/manuring as it induces heavy vegetative growth.

Interculture: One thorough hand hoeing may be given three weeks after sowing. Thin out the extra crop plants during interculture operation to maintain plant to plant distance of 15 cm within rows.

Harvesting and Threshing: Timely harvesting of the crop is very important, otherwise the shattering of the seed takes place. The plants are harvested when they turn pale at maturity and are tied into small bundles for stacking. Two shakings of the bundles are enough to collect the entire produce.

Important Hints for Maximizing Sesamum Yield.

1. Prepare a well pulverized seed bed containing sufficient moisture.
2. Use good certified seed of a recommended variety.
3. Follow the recommended plant protection measures.
4. Heavy manuring should be avoided.
5. Harvest the crop at proper time otherwise shattering of seed will take place.

Plant Protection

I. Major Insect pest and their Management

Hairy Caterpillars, Leaf Roller, Pod Borer, Aphids & White Fly are the important insect pests which damage the til crop.

(i) Collection and destruction of first and second instar larvae of hairy caterpillars present on underside of skeletonized leaves.

(ii) Dust the crop with chlorpyhriphos 1.5% D @ 10 kg/acre or spray the crop with chlorpyriphos 20EC @ 2 ml/litre of water or quinalphos 25EC @ 2ml/litre of water or acetamipride 20SP @ 0.2 g/litre of water with knap sack pump. This will also control other insects besides hairy caterpillars.

White Fly: These flies damage the crops by sucking the cell sap from leaves and pods. White fly also spread mosaic virus from one plant to another. Spray the crop with dimethoate 30 EC @ 2 ml/litre of water or demeton methyl 25 EC @ 1 ml/litre of water or imidacloprid 17.8 SL @ 0.3 ml/litre of water.

II.Major Diseases and their Management

Name of the disease and symptoms of attack	Control Measures
Phyllody: In case of phyllody, the floral parts are transformed into green leafy structures followed by profuse branching and plants assume a bunchy top appearance and no seed are formed.	Rogue out the diseased plants to prevent further spread of the disease. Spraying the crop with metasystox @ 1 ml in 1 litre of water which will be effective in preventing the disease spread.
Bacterial Blight: Numerous golden yellow spots appear on leaves and pods.	The disease can be managed by spraying the crop with copper oxychloride @ 0.3%.

Eco-friendly management of major insect pests of Sesame

IPM module (Bio-inoculant (Azospirillum) + Intercropping (with mungbean 3:2) + Mechanical control + Cow urine + Yellow sticky trap) is recommended for achieving higher sesame equivalent yield (498.91 kg/ha) over the recommended practice and reducing the insect pests and Phyllody incidence in sesame.

2.2 GROUNDNUT

Soil: A well drained sandy soil overlying a loamy sub-soil is considered ideal for a rainy crop. Where irrigation facilities are available, sandy loam and loamy soils were found best for groundnut cultivation.

Varieties

Punjab-1: This variety has wider adaptability having grain yield potential of 7-8q/acre. It has a shelling percentage of 69 and seeds contain 49 percent oil content.

M-13: The variety having large sized pod, dark green with waxy coating leaves having grain yield potential of 11q/acre. It has a shelling percentage of 68 and seeds contain 49 percent oil content.

JL-24: This variety early maturing having large dark green leaves, smooth pod, compact bearing widely adopted. It matures in 95 days.

Agronomic Practices

Seed Rate and Seed Treatment: Healthy and well filled pods should be hand shelled about a fortnight prior to sowing. Treat the seed with copper oxychloride @ 3g/kg seed. About 40 kg of pods are sufficient for one acre.

Time of Sowing: The rainfed crop can be sown in March/April and from the last week of June to Ist week of July with onset of monsoon in the sub-tropical area of Jammu division. Irrigated crop should be sown during first fortnight of June after pre-irrigation. Seed should be sown by *Kera*, *Pora* or drilled at depth of 5 cm. Row to row spacing of 30 cm with 22.5 cm plant to plant distance is maintained.

Fertilizers and Nutrient Management: Apply the fertilizers as per recommendations of the soil test results. However, in general recommendations are as under:

Nutrient (kg/acre)			Fertilizer (kg/acre)		
N	**P**	**K**	**Urea**	**DAP**	**MOP**
8	16	10	4	35	17

Drill all fertilizers at the time of sowing. Gypsum @ 50kg/acre should be broadcasted. Prefer phosphorus dose from Single Super Phosphate (SSP).

Zn deficiency: Reduction in size of leaves is observed in Zn deficient soils. The colour of leaves changes to light yellow. When the deficiency is severe, the plant growth is stunted and the kernels are shrivelled. Apply 1kg $ZnSO_4$ Heptahydrate (21%) or 800g $ZnSO_4$ Monohydrate (33%) per acre. The dose should not be repeated for atleast 2-3 years.

Note: Soils of Jammu province are generally low to medium in nature, so it is advised to apply phosphorus according to the soil test report.

Drill entire quantity of DAP & MOP with last ploughing.

Interculture: Care should be taken to keep soil loose so that pegs can penetrate easily for pod formation. After third week of sowing, give one hoeing. Give 2nd hoeing and weeding in the 6th week of sowing. Earthing up should be carried out simultaneously with intercultural operations. Do not burry the plants in earthing up operation. No cultural operation should be done 45 days after germination as pegs penetrate the soil in 45 days old plant as this is Pegging stage.

Gap Filling: After germination, if the gaps are observed, fill them by dibbling groundnut kernels or moong or urd seeds.

Irrigation Water Management: 2 to 3 irrigations are required. First irrigation be given at the start of the flowering and subsequent irrigations may be given whenever required.

Harvesting: A reliable indication of maturity is the uniform yellowing of leaves as well as the shedding of older leaves. The crop should be harvested when most of the

leaves turn yellow and start shedding. The harvested crop should be left in small heaps for two to three days for curing. Collect the pods and leaves into a heap and winnow. The pods should be sun-dried, for 4 or 5 days before storage.

Plant Protection

I. Major Insect Pests and Their Management

Termites, Hairy Caterpillars, Aphids, Jassids, Leaf Miner and White Grub are the important insects which damage the groundnut crop.

Termites can be controlled by mixing cartap hydrochloride 4G @ 10kg/acre in the soil with the last ploughing.

Hairy caterpillars control same as in Til crop.

Aphids, jassids and leaf miner can be controlled by spraying the crop with methyl demeton 25 EC @ 1ml/litre of water or dimethoate 30 EC @ 2 ml/ litre of water. The infestation with White grub can be managed as in maize crop.

II. Major Diseases and their Management:

Among the diseases, Stem rot and Tikka diseases are important.

Name of the disease and symptoms of attack	Control Measures
Tikka Disease: (*Cercospora arachidecola*) infection starts about a month after sowing. Small chlorotic spots appear on leaflets, with time they enlarge and turn brown to black and assume sub circular shape on upper leaf surface. Lessions also appear on petioles, stems, stipules. In severe cases several lesions coalesce and result in premature senescence.	Spray the crop with difenoconazole @0.1% or hexaconazole @ 0.1% at 15 days interval.
Stem rot: (*Sclerotium rolfsii)* Pustules appear first on the lower surface and upper surface or the leaflet. They may be formed on all aerial plan parts from flower and pegs. Severely infected leaves turn necrotic brown and desiccate but are attached to the plant.	Seed treatment with biological control agents such as *Trichoderma veride* @ 4g/kg of seed or tebuconazole @ 1g/kg of seed.

3. PULSE CROPS

3.1 MOONG AND MASH

Mash and Moong are the most important pulse crops of rainy season. Pulses are next to cereals as main valuable source of protein. Growing of pulse crop also improves soil fertility.

Climate: These crops thrive best under hot and humid climate of subtropical plains.

Soil: These pulse crops do well on all type of soils, but light sandy loam to heavy clay are ideal soils for mash/moong cultivation. Prefer heavy soils for moong cultivation.

Varieties

Mash

1. **Pant U-19:** It is early maturing (80-85 days in kharif and 75 days in spring/summer). Plant is erect, pods hairy, seed black, medium in size and resistant to yellow mosaic virus disease. Its seed yield potential is 4.4q/acre
2. **Uttara (IPU-94-1):** It is resistant to yellow mosaic virus, matures in 85 days and its average seed yield is 4.6 q/acre. It is recommended for *kharif* season.
3. **Pant U-31:** It is resistant to yellow mosaic virus (YMV), matures in 75-80 days with seed yield potential of 6 q/acre.
4. **NDU 99-3:** It is resistant to yellow mosaic virus (YMV). It matures in 80 days and its seed yield potential is 3.8 q/acre. This variety is recommended for cultivation in *kharif* season.
5. **KUG 479:** It is resistant to yellow mosaic virus (YMV), matures in 70-75 days with seed yield potential of 4.4 q/acre. This variety is recommended for spring season.

Mungbean

1. **Pant Mung-6:** It is resistant to MYMV, CLS, BLS and leaf crinckle, matures in 96 days.Its seed yield potential is 4.16 q/acre.
2. **PDM 54 (Moti):** It is Early maturity, large seeds, multiple disease resistance
3. **Pusa Vishal**: It is resistant to YMV, tolerant to jassids and whitefly, suitable for summer, very bold seeded (6g/100 seed) variety. Its seed yield potential is 4.4 q/acre.
4. **Ganga-8 (Gangotri**): It is tolerant to stem fly and pod borer, matured in 72 days with seed yield potential of 3.68 q/acre.
5. **Shalimar Moong-1**: It is resistant to leaf spot, pod blight, mature in 105 to 115 days with seed yield potential of 3.6 q/acre.
6. **SML 668:** It is resistant to anthracnose, cercospora leaf spot & amp; YMV, matured in 75-85 days with seed yield potential of 4.6 q/acre. It is under irrigated condition in summer as contigent crop or intercrop in sugarcane,
7. **KM 2241**: It is resistant to MYMV, suitable for kharif, matured in 65-70 days

with seed yield potential of 3.6 q/acre.

8. **IPM 2-3:** It is resistant to MYMV, large seed, suitable for kharif and spring, matured in 70-72 days with seed yield potential of 4q/acre.
9. **Pusa 0672:** It is resistant to MYMV, suitable for kharif, with seed yield potential of 6.4 q/acre
10. **Satya:** It is suitable for kharif season, matures in 70 days with seed yield potential of 6.6 q/acre.

Agronomic Practices

Field Prepartion: Plough the land with Tawi plough followed by 1-2 ploughing with *desi* plough or disc harrow. Each ploughing should be followed by planking to get the desired tilth.

Seed Rate: Use 6 kg to 8 kg of seed per acre. Treat the seed with copper oxychloride @ 3g per kg of seed, before sowing.

Seed Inoculation: It is better to inoculate the seed with *Rhizobium* culture before sowing for getting higher yields.

Time & Method of Sowing: *Kharif* mash crop is sown with onset of monsoon upto 15th July in sub-tropical area and end of June in intermediate area upto 750 m altitude. However, upto 800 m altitude, it can be sown upto 1st week of July. Summer crop of mash is sown from 15th March to 1st week of April. However, summer moong can be sown upto 20th April. The crop should be sown in lines 30 cm apart by *Kera* method. The seed should be sown 4 to 6 cm deep.

Fertilizers and Nutrient Management: It is better to get the soil tested and apply fertilizers according to the recommendations. In general, following schedule of fertilizer combination is recommended:

Nutrients (kg/acre)		Fertilizer (kg/acre)
N	**P_2O_5**	**DAP**
6	16	35

Whole quantity of DAP should be drilled before sowing with *pora*.

Cultural Weed Control: Give one weeding and hoeing one month after sowing when the plants acquire the height of 15-20 cm with hand blade hoe, khurpa or medium cultivator.

Irrigation water Management: Generally during *kharif*, mash crop does not require any irrigation, but in case of failures of rains, the crop should be irrigated especially at pre-flowering and pod formation stage. In case of heavy rains, water should be drained off from the field, otherwise it will damage the crop.

In case of summer sowing, regular irrigations at an interval of 10 to 15 days may be given to the crop. However, for summer crop requires 2 irrigations under heavy soil, 3 under medium and 4 under light soil conditions. Last irrigation should be given at pod formation stage.

Harvesting: The crop may be harvested when the leaves fall off and most of the pods turn greyish black. Uprooting of the matured crop should be avoided. Threshing should be done by using conventional method.

Plant Protection

I. Major Insect Pest and their Management:

Adopt the following measures to control the insect pest and diseases.

i) Mechanical control same as in Til crop.

ii) **Hairy caterpillar**:
   a.) Collection and destruction of egg masses and early insta larvae present on the underside of leaves.
   b.) Hand pick and destroy grown up caterpillars.
   c.) Spray chlorpyriphos 20EC @ 2ml/litre of water or 480 ml/acre in 240 litre water or quinalphos 25EC @ 2ml/litre of water.

iii) **White fly and aphids**: These damage the crop by sucking the cell sap from leaves and pods. White fly also spreads mosaic virus from one plant to another.
   a.) Grow yellow mosaic resistant/tolerant varieties.
   b.) Pull out and destroy by burning the plants showing symptoms of yellow mosaic, leaf curl and leaf wrinkle virus diseases as these insects act as vectors.
   c.) Use yellow sticky traps.
   d.) Spray the crop with methyl demeton 25 EC @ 1ml/litre of water or dimethoate 30 EC @ 1ml/litre of water or imidacloprid 17.8 SL @ 0.3 ml/litre of water.

II. Major Diseases and their Management

Symptom	Management
Cercospora leaf spot (*Cercospora canescens*): Brown or black circular to angular spots are formed on leaves. During humid weather, the spots become so numerous that they merge with each other resulting in premature death of leaves.	Spray the crop with tebuconazole @ 0.1 % at fortnightly intervals starting after 45 days of sowing or when the first symptoms of the disease appear, 2-3 sprays may be given depending upon disease severity.
Ascochyta leaf spot (*Ascochyta phaseolorum)*: Dark coloured, circular lesions with concentric rings are formed on leaves. In severe cases, short holes surrounded by remanants of concentric rings are formed.	Spray the crop with tebuconazole @ 0.1 %.
Anthracnose *(Collectotrichumcapsici):* Crescent-shaped, dark brown spots are formed on leaves. Lateron spots develop concentric rings. In severe cases, the lesions may coalesce resulting in burnt appearance. Dark coloured spots are also seen on pods.	Spray the crop with tebuconazole @ 0.1 %

Powdery mildew: (*Erysiphe polygoni*) A white powdery growth occurs on the leaves spreading to cover the stem and other plant parts. The disease is more severe when the plants are in flowering stage and persists until harvest.	Spray the crop with tebuconazole @ 0.5 ml/litre of water.
Yellow mosaic: (Moong bean yellow mosaic virus) The leaves show yellow patches alternating with green areas which also turn yellow and gradually change to whitish shade and finally become necrotic. Affected plants are dwarfed. Flowering and seed setting is very poor.	Obtain seed from disease free crop grown in disease free areas such as higher hills. Rogue out diseased plants in early stages. Control insect vectors with sprays of thiamethoxam @ 0.03%.

3.2 SOYBEAN

Soybean is an important industrial crop being presently used in the antibiotic food processing and vegetable ghee making factories. A small portion of produce is also consumed as pulse. It contains 40% protein and 20% oil. Soybean protein is rich in essential amino acid lycine (5%) besides it contains good amounts of minerals, salts, vitamins (thiamine and riboflavin). Sprouting soybean grains contain good quantity of Vitamins C and A. Soybean oil is used in the manufacture of "vanaspati ghee". This crop improves soil fertility. It can be used as fodder, forage and can be made into hay and silage. Soybean is the richest, cheapest and easiest source of proteins and fats with multiple uses in food and industrial products that is why it is known as Wonder Crop.

Climate Requirement: Though soybean is a crop of temperate region, it grows well in plains as well, from the end of June to October.

Soils: It can be grown under a wide range of soils but fertile well drained loamy soils are best for its cultivation. The soil pH of 6 to 6.5 is best to the nodulation bacteria for the efficient conversion of atmospheric nitrogen. Water logging is harmful to the crop.

Varieties

1. **BRAGG:** It is resistant to bacterial pustules and susceptible to YMV. It has white flowers, grey pubescence, yellow seed coat, black hilum, brown pods. It matures in 112-115 days with seed yield potential of 7q/acre.
2. **VL Soya 59:** It has low linolenic acid which improves oxidative stability of soybean oil which improves its commercial value. It has moderate multiple resistance against pod blight and frog eye leaf spot. Its average yield potential is 10.25q/acre.
3. **VL Soya 63**: It is resistant to pod blight, target leaf spot and moderate resistant to frog eye leaf spot.Its average seed yield is 11q/acre.
4. **VL Soya 89 (VLS 89**): It is suitable for timely sown rainfed conditions of northern hill zone, matures in 116 days, moderate resistance to frog eye leaf

spot and pod blight diseases, promising against bugs and leaf hoppers with seed yield potential of 9.2q/acre.

Agronomic Practices

Land Preparation: The land should be ploughed once with Tawi plough followed by disc harrow or desi plough two to three times. Each ploughing needs to be followed by planking so that good tilth is obtained.

Seed Rate: Use 25 kg of seed per acre.

Seed Inoculation: Soybean is a leguminous crop & requires special treatment of seed with bacterial culture (*Rhizobium* culture) for its establishment in the area. The seed should be inoculated with bacterial culture at sowing time. Smear the seeds with 10% solution of Jaggery. Add bacterial culture and mix it well in the seed and sow the treated seeds immediately.

Time and Method of Sowing: Soybean is sown with the onset of monsoon in the 1st week of July in subtropical areas. In other areas, its sowing time coincides with maize sowing. Heavy rains immediately after sowing adversely affect germination. It should preferably be sown after the pre-monsoon showers. The seed should be sown in lines 45 cm apart at an optimum seed depth of 2.5 to 5 cm. Maize should be planted at a distance of 50 x 20 cm for attaining its optimal yield under rainfed conditions.

Manures and Fertilizers: Apply the following plant nutrients to get a good yield. These plant nutrients can be made available from the following fertilizers:

(kg/acre)					
N	**P_2O_5**	**K_2O**	**Urea**	**DAP**	**MOP**
8	16	8	4	35	13

Apply whole quantity of DAP, MOP and urea at the time of sowing. Green manuring the field with sunhemp using 20 kg seed/acre during 2nd fortnight of April. Green manure crop should be buried when about 40-50 days old and allow to decompose for about 10 days before sowing of soybean. Apply full dose of nitrogen (12 kg N/acre) to get high yield of soybean in soybean-wheat system. It improves the soil health by improving the soil physical, chemical and biological properties.

Interculture: Weeding and hoeing should be done after 15th and 35th day after germination with khurpa or V-blade hoe.

Irrigation water management: It is a rainy season crop and generally no irrigation is given. However, if rains fail during the growing period, irrigation at the time of pod filling is very useful.

Harvesting: The crop should be harvested when leaves fall off and the pods change colour. The harvesting of the crop should not be delayed otherwise the shedding of grains from pods will take place.

Threshing: The threshing can be done with the conventional methods used in case of

other pulses. Care should be taken to avoid severe trampling, as it reduces the quality and germination of the seed.

Storage: The moisture content of seed for storing should not exceed 7%. The seed should be stored in dry bins or in the bags kept on wooden racks. The properly stored seed remains viable for about a year. The seed can, however, be stored for a longer period for other uses.

Plant Protection

Major Insect Pest and their Management

1.	Hairy Caterpillars	i) Mechanical control same as in Til crop. ii) Dust the crop with quinalphos 25 Ec @ 2ml/litre of water or spray the crop with chlorpyriphos 20 EC @ 480ml/acre.
2.	Jassids and White Fly	Spray the crop with dimethoate 30 EC @ 2 ml/ litre of water.

3.3 COWPEA

Cowpea is mostly grown in rainfed areas during rainy season as a mixed crop with maize or as a pure crop. It is an important pulse crop in the intermediate region of Jammu province. For getting higher yield from this crop, the following packages of practices are recommended:

Climate: It requires warm climate and can be grown during summer and *kharif* seasons.

Soil: It thrives best on light to heavy loam soils with good drainage facility especially during rainy season. However, for summer crop (March-June) heavy soils are better, since such soils are water retentive and as such numbers of irrigations required are less.

Varieties:

1. **CS 152**: Its grains are of brown colour. Its potential seed yield is 6 to 8q/acre during summer and 3.2-4q/acre during rainy season.
2. **Pant Lobia-3:** It is 50-55 cm tall bush type variety, resistant to YMV and bacterial blight. Seeds are kidney to oval shape and brown in colour. It has 27% protein, matures in 65-70 days with potential seed yield of 12.8q/acre.
3. **Pant Lobia-4:** It has tolerance to major bacterial and viral diseases like yellow mosaic, photo insensitive and drought tolerant, adaptable to zaid season, matures in 60-65 days with average seed yield of 12.8q/acre.

Agronomic Practices

Land Preparation: 2 to 3 ploughings followed by planking (sohaga) are sufficient to

get good seed bed. The field should be free from root stubble, grasses and clods.

Time of Sowing: During summer, it should be sown from 15th to 30th March under irrigated condition in the areas of Jammu plains. Infact, it can be sown after the harvest of sarson and barley as a third crop in sequence in paddy growing areas especially with culture-I variety.

During *kharif*, it should be sown with the onset of monsoon upto 10th July. However, its sowing can be extended upto 3rd week of July with culture-I variety in sub-tropical areas. In hills, its sowing time coincides with time of maize sowing.

Seed Rate: Use 8-10 kg/acre seed for pure crop and 4 kg/acre for mixed crop with maize.

Seed Inoculation: Inoculate the seeds with *Rhizobium* culture before sowing.

Fertilizers and Nutrient Management: As a pure crop, it requires 7 kg nitrogen and 18 kg phosphorus/acre i.e. 39 kg DAP/acre, when grown mixed with maize use N, P, K doses as required for maize. For additional benefit use *Rhizobium* culture. In soils where cowpea is grown after Rabi-wheat and where wheat has received recommended level of phosphorus, in that case application of phosphorus should be skipped. However, if the soil test report shows high deficiency of phosphorus then there is need to apply phosphorus.

Irrigation Water management: It should be grown as irrigated crop during summer season in Jammu plains. Under such conditions, it requires 4-6 irrigations under light soil and 2-3 under heavy soil conditions. During summer, it should be sown in heavy soil where paddy is grown. One irrigation at 15-20 days after germination and two during flowering are sufficient to get higher yield. During *kharif* it is grown as rainfed crop only.

Hoeing and Weeding: Care should be taken that during the first month of the crop, there should be no weeds in the crop. As such, one weeding 15-20 days after germination is sufficient. It forms canopy at a very early stage and thereby has a smothering effect on weeds.

Harvesting: It requires two pickings and then final harvesting. At the time of harvesting, green stalks can be fed to the cattle as fodder after picking the matured pods during both the season.

3.4 RAJMASH

Maize and rajmash are grown mixed in hilly area of Jammu division. It can be grown as a pure crop. Sowing of rajmash as a pure crop is not economical because returns from a pure crop are meagre. Most of the local rajmash varieties are red seeded twinning type which requires arrangements for support during the crop growth period. So when sown mixed it gets natural support from maize plants.

Soil: Well drained loams soils are the most suitable ones for its growth.

Varieties:

For maize crop: Hybrid varieties of maize are Vivek maize hybrid 47, Vivek maize hybrid 53, Vivek maize hybrid 45, VL maize hybrid 57, PHM-12 are recommended.

For rajmash crop: Pole type local variety of rajmash namely Bhaderwah local rajmash (Chinta selection) is recommended.

Agronomic practices

Land preparation: Crop requires fine seedbed and adequate soil moisture for good germination. A deep ploughing followed by 2-3 harrowings and planking is adequate to obtain required tilth.

Time of Sowing: The crop is sown during second fortnight of April to first fortnight of May.

Seed treatment: Before sowing, the seed of both crops should be treated with copper oxychloride @ 3g/kg of seed.

Seed rate: Seed rate of 16 kg/acre is recommended for maize crop whereas 9.5 kg/acre of seed is recommended for rajmash crop.

Spacing and method of sowing: Maize crop should be sown at recommended spacing of 75 cm x 20 cm and a row of rajmash is taken in between the two rows of maize. The sowing should be done in proper moisture conditions at a depth of 5 cm.

Manures and Fertilizers: The requirement of nutrient is as same as for the maize crop and no additional fertiliser dose is given to the intercrop of rajmash.

Recommended dose of fertilizer for Maize + Rajmash intercropping are:

S.No.	Manure/ Fertilizer	Total	Basal	Top dressing	
				1st	2nd
1	Urea	30 kg/ acre (13.8 kg N/acre)	4 kg/acre	13.2kg/acre	12.8 kg/acre
2	DAP	27kg/ acre (12 kg P_2O_5/ acre +7 kg N/ acre)	27kg/acre	-	-
3	MOP	10 kg/ acre (6 kg K_2O/ acre)	10 kg/acre	-	-
4	FYM	1.5 t/acre	1.5 t/acre (6 kg N)	-	-

Application of fertilisers: Incorporate FYM into the soil thoroughly along with first ploughing. Drill the entire dose of DAP, MOP and 1/3rd dose of N through urea at the time of sowing. Remaining amount of urea should be applied in two equal doses, 1st

top dressing should be done at knee high stage and 2nd top dressing at tasseling stage.

Irrigation: As a rainy season crop, it does not require irrigation, when rainfall distribution is even throughout crop cycle. But if rain fails, irrigation at 25-30 days after sowing (DAS) is critical.

Weed control: Weeds are controlled by manual hoeing and hand weeding at 25 DAS and at knee high stage (40-45 DAS).

Harvesting: The hybrid and composite maize plants remain green even when the crop is ready for harvest. When husk cover over the cobs dries and turns brown and grain hardens, the crop should be harvested. Harvesting time varies as different varieties have different maturity groups. The grains from dried cobs should be shelled with traditional methods or with hand corn-sheller and dried in sun for safe storage. In case of rajmash, the pods from the earlier flushes of flowers mature earlier, which exhibit shattering tendency and should be hand picked. The pods from later flushes are to be harvested subsequently.

Yield: By adopting the above production techniques about 20-40 q/acre of yield on maize equivalent basis can be realized.

Plant Protection

I. Major Insect Pests and their Management

Aphids: These damage the crops by sucking the cell sap from leaves and pods. Aphids also spread yellow mosaic virus from one plant to another. To control the aphids spray the insecticides as in case of previous crops.

II. Major Diseases and their Management

Rajmash	
Anthracnose (*Colletotrichum* spp.): All plant parts above ground level and at any stage of plant growth are attacked. The most prominent symptom is characteristic spotting on the pods. Water soaked lesions appear on the pods which become brown and enlarge to form circular spots of varying sizes. The spots are usually depressed with dark centres and bright red, yellow or orange margins. In moist weather, pink masses of spores are present on the spots.	1. Obtain seed from disease free locations. 2. Treat seed with copper oxychloride @ 3 g/kg of seed.
Angular leaf spot *(Phaeoisariopsis griseopla)*: Numerous small, angular, brown spots appear on foliage and on pods, dark brown to black, circular spots are formed. Sometimes pods are deformed.	1. Use healthy seed. 2. Treat seed with copper oxychloride @ 3 g/kg of seed. 3. Spray the crop with chlorothalonil @ 2g/litre of water at fortnightly intervals starting from flowering or when the first symptoms of the disease appear.

	2-3 sprays should be done depending upon the disease severity.
Floury leaf spot (*Ramularia phaseoli*): White powdery growth resembling flour appears on lower surface of leaves when the crop is in flowering stage. The disease leaves are shed prematurely.	As in case of angular leaf spot.
Bacterial blight (*Xanthomonas axonopodis* pv. *Phaseoli* var. fuscans): The disease appears early in the season. Translucent water-soaked spots are formed on leaves which turn yellow and die. Lesions of various shapes and sized are visible on dead leaves. Small spots also appear on pods.	1. Obtain seed from disease free area. 2. Follow crop rotation of 3 years.

4. FODDER CROPS

4.1 LUCERNE (Medicago sativa)

This is an important perennial leguminous forage crop and is generally known as queen of fodders. It is highly nutritious containing more than 20% protein content. It can also be grown successfully in orchards. The crop can be raised upto an altitude of 3300 m or more. It is resistant to frost and can also withstand temperature upto 49°C and drought as well. Average height of the plant is about 80 cm.

Varieties:

Sirsa Type 9: It is a quick growing perennial variety with deep green foliage. Its yield potential is about 320–330 q/acre of green fodder and 1.00 to 1.80 q/acre seed. It is most suitable for growing in north India where cold temperature prevails.

RL-88: The variety has been recommended for cultivation for year round irrigated situation in all zones of the country. This first cut of the crop can be taken in 50–60 days of sowing and thereafter cut can be taken at 25–30 days. The variety is resistant to major diseases and pests and yields 300–400 q/acre green fodder in 11 cuts.

LL Composite 5: It is a tall, erect and fast growing annual variety. It has broad leaves with purple flowers. It has bold seeds and highly resistant to downy mildew. It gives 8 cuttings up to 1st week of July and yields 280 q/acre green fodder.

Agronomic Practices

Preparation of Land: The crop thrives well in deep black loamy and light soils. The land should be ploughed 4-5 times till fine tilth is attained to ensure better contact of seeds with soil particles for better and quick germination. Crop growth is hampered if the land is not free from weeds. The soil should have sufficient moisture at the time of sowing. The plots should be well levelled to facilitate proper irrigation. It is preferred if the land is divided into small plots of 10 x 20 or 20 x 30 sq. m for efficient irrigation.

Sowing Time: Under the temperate agro-climatic regions Lucerne can be sown in three different seasons i.e. spring (April to ending May), summer (July to August) and autumn (September to ending November). Autumn sowing is usually preferred. But in the tropical and sub-tropical areas, September to November is the only suitable time for sowing of this crop.

Seed Rate: For line sown crop 6 kg to 8 kg of seed/acre is enough to obtain good yield. Whereas seed rate of 8-10 kg of seed/acre is sufficient when the sowing method is broadcasting

Seed Inoculation: Inoculate the seed with *Rhizobium melioti* culture before sowing.

Method of Sowing: Three methods are usually followed. Broadcasting is adopted for fodder production, but for seed production line sowing or sowing on ridges is preferred. The crop should be sown in rows 30-40 cm apart. To soften the harder seed coat the seeds should be soaked overnight in water and should not be sown more than 1 cm deep as shallow sowing ensures proper germination.

Manures and Fertilizers: 2 to 3 tonnes/acre of well rotten FYM should be applied and mixed with soil well before sowing. 24 kg P (52 kg DAP/acre) and 2 kg N/acre (4.35 kg urea/acre) is given as basal dose. After 1st and 3rd cutting, application of 32 kg of DAP/acre ensures better fodder yield. In subsequent year, apply equal quantity of fertilizers i.e. full P and nitrogen in split doses after each cut.

Irrigation Water management: Irrigation requirement for Lucerne is quite heavy. In orchards, it can be grown under normal irrigations. 4 to 5 irrigations are essential between sowing and 1st cutting and sub-sequent irrigations are given at 10-15 days interval. At any cost, the soil should be kept moist till satisfactory germination is obtained. Irrigation after every cut is must.

Harvesting As the crop takes long time to establish, the 1st cut is often delayed and gets ready in about 70 to 90 days. Subsequent cuttings are taken at an interval of 30-45 days depending upon how well the crop is looked after. Cuttings are usually taken when the height of the crop is 30-40 cm. Under normal conditions 240-320 q/acre of green fodder is obtained in a year.

Note: Lucerne like red clover and berseem when fed whole, cause bloating in cattle, which often proves fatal. It is as such advised to feed the fodder chaffed and mixed with some chaffed straw. No such need arises when fed in the form of hay. Lucerne can be grown mixed with grasses/crops such as Rhodes grass, Guinea grass, anjan grass etc.

4.2 HYBRID NAPIER

It is perennial vegetatively propagated crop but most of the green fodder becomes available during summer months from March to October. Its growth is checked during winter but resumes as soon as season changes. It requires hot and moist climate and can be grown in Jammu, Kathua and some parts of Udhampur district. It can also be grown successfully on lower hills.

Varieties

Pusa Giant: It provides high yield of 1000-1200 q/acre/year of green matter under irrigated conditions. It contains 25 percent and 12 percent more protein and sugar respectively than common napier grass. It is less fibrous, juicy and palatable.

NB-21: It is a fast growing variety with high tillering capacity. Stems are thin and non-hairy with long, smooth and narrow leaves. Oxalic acid content of this variety is comparatively lesser than other varieties but it has become susceptible to diseases.

Agronomic Practices

Land Preperation: Light fertile loamy and sandy soils are good for propagation as crop does not tolerate stagnant water. Land is usually prepared by giving one deep ploughing followed by two harrowings and plankings.

Time of Planting: It can be planted from mid February to end of March and mid June to end of July but latter planting is better.

Method of Planting: It is propagated by root slips or even by stem cuttings. One root slip per hill or one stem cutting with 2-3 nodes at the rate of 7200-8000 plant per acre are needed. A small portion of the shoot or bud is kept in the open and rest is buried in the soil.

Keep 80 cm distance between rows and 60 cm within the rows from plant to plant in case of sole crop, whereas intercrop with maize/cowpea fodder in *kharif* and berseem in *rabi* season, the planting distance shall be 1.2 m × 60 cm.

Manures and Fertilizers: Apply 2 tonnes of well rotten compost or FYM/acre at time of land preparation. Under Irrigated conditions, apply 32 kg N (Urea 57 kg/acre) and 16 kg P (DAP 35 kg/acre) whereas under un-irrigated conditions, apply 16 kg N (Urea 29 kg/acre) and 8 kg P(DAP-18 kg/acre). Full dose of P may be applied at the time of planting. Nitrogen may be applied in equal split doses after each cutting. Repeat the same schedule of fertilizer every year.

Irrigation Water management: Proper drainage should be provided during rainy season as it is susceptible to water logging. The crop should be irrigated at an interval of 10 to 15 days during the mid seasons and interval should be reduced during hot summer months.

Interculture: Each cutting should be followed by light ploughing to keep the soil loose and friable.

Intercropping: During *kharif* no intercrop can be taken due to its heavy growth. During *rabi* senji or tetraploid berseem can be taken as an intercrop. Ordinarily berseem cannot be sown as intercrop because dormancy period of napier is short.

Harvesting: First cutting is ready about 50-60 days of planting and subsequent cuttings are ready in 30-35 days interval during the growing period.

Note: Napier fodder contains 3-6% oxalate content which can further damage the kidney of animals and also deplete their body calcium so this fodder should be mixed with leguminous fodder or mineral mixture to compensate the loss of calcium from their body.

4.3 COWPEAS FODDER

It is one of the most important *kharif* legume containing about 17% protein. It can be grown in combination with Jowar and bajra for increasing the nutritive value of fodder under irrigated as well as rain-fed conditions. It is also hay crop. It grows very well under orchards.

Varieties:

Bundel Lobia-1 (IFC - 8401): It grows up to 120– 130 cm with 5–7 branches. It possess medium to broad leaves with light green colour, Seed shape is rectangular to round. It is suited to drier areas with moderate rainfall. It is ready for green fodder harvest in 60– 65 days. The green fodder yield is 12-14 t/acre anddry-matter yield is 1.5-2.0 t/acre.

Bundel Lobia-2 (IFC - 8503): The plant height is 140–150 cm with 4–5 branches. The growth habit is erect to semi-erect with tendrils. The leaves are medium to broad and light green in colour.The variety is suited to drier areas with moderate rainfall. The fodder yield is 12-14 t /acre green and 1.3-1.6 t/acre dry fodder and 17% crude protein.

EC 4216: The plants are erect to semi-erect, 140-150 cm long and climbing type. The green fodder yield is 12 t/acre and dry matter yield is 2.2 t /acre. This variety is high in CPC and moderately resistant to drought.

HFC-42-1 (Hara Lobia): This is an erect variety with dark green foliage and is suitable for mixed cropping. It gives green fodder yield of 10.5 t/acre.

Type-21: The plants have dark green leaves and provides 13 t/acre green fodder and 2 t/acre dry fodder.

Land Preparation: Two to three ploughings followed by planking is necessary to get the fine tilth

Time and Method of Sowing: Sowing starts from Ist week of April and continues upto the end of July. For fodder, the seeds are sown by broadcasting but for seed production, seeds are sown in lines 45 cm apart.

Seed Rate: 20-24 kg/acre depending upon the method of sowing.

Seed Inoculation: Inoculate the seed with *Rhizobium* culture.

Mixed Cropping: Cowpeas can be grown mixed with guara, teosinte or makchari , bajra, chari and nappier.

Manures and Fertilizers : To ensure a good stand and yields, 24 kg P(52 kg DAP/acre) & 8 kg N/acre(17 kg urea/acre) is given as basal dose, 8 kg N/acre (17 kg urea/acre) is top dressed after 40 days of sowing.

Interculture: Weeding is essential during the early stages of crop growth. Line sown

crop needs 2-3 weedings to ensure proper expansion of fast growing vines.

Irrigation Water management: Under irrigated conditions 2-3 irrigations are required. The crop is raised successfully under rainfed conditions also.

Harvesting and Yield: Fodder crop is ready for harvest in 60-70 days time. Seed crop is ready in 110-120 days. The plant after seed picking, is also fed to cattle. Fodder yield varies from 60 to 80 q/acre.

4.4 BAJRA FODDER

Bajra is an important *kharif* fodder crop and can be grown both under irrigated and rain-fed conditions. This crop is suitable for *kandi* areas of this division. It can with stand prolonged drought. It is also a good silage crop. It is good forage crop especially for milch cattle when sown mixed with cowpeas fodder.

Varieties:

Giant Bajra: Plants are leafy with profuse tillering and have 9-10% protein at boot stage. The variety is good for hay and silage making. It is moderately resistant to downy mildew and ergot diseases. The green fodder yield is 20–30 t/acre.

FBC-16: This is a multi-cut variety, resistant to major diseases. The variety has low concentration of oxalates and high voluntary dry matter intake by the animals. The green fodder yield potential is 28–32 t/acre.

PCB 164: Dual purpose composite variety having medium thick stalks and 15.0 flexible stem with average plant height of 207 cm. It matures in 80 days. This variety has long cylindrical dense ears having, 27-28 cm length and 8-10 cm girth. The grains are medium bold and light slate in colour. It is highly resistant to downy mildew.

Agronomic Practices

Field Preparation: Light soils are preferred for its cultivation, 2-3 ploughings are sufficient. Removal of stubbles from field is essential.

Sowing Time and Method of Sowing: Sowing of bajra starts from ending April to mid May and can be extended upto mid July under rain-fed conditions. For fodder production, broadcasting is preferred. Seeds are sown in lines 50-60 cm apart.

Seed Rate: 4 kg of seed/acre is recommended. The crop is also sown mixed with legumes like cowpeas or guara. The seed rate in that case is reduced to half.

Manures and Fertilizers : Apply 3 to 4 tonnes/acre of well rotten FYM at lease 3-4 weeks before sowing, 12 kg N (Urea 13 kg/acre) & 16 kg P (DAP 35kg/acre) is also applied as basal dose. 12 kg N/acre (Urea 26 kg/ha) is given as top dressing followed by irrigation or before the rain is expected.

Irrigation Water Management: The plants should not be allowed to wilt. The crop is harvested when the plants are succulent and earing has started.

Yield: Fodder yield varies from 10-13 tonnes/acre depending on the number of cutting taken which vary from 2-3 under irrigated conditions.

4.5 JOWAR

Jowar is one of the important *kharif* fodder crops grown both under irrigated and rain-fed conditions. It gives best stand where there is low rainfall and high humidity. Jowar is also relished very much by cattle as silage.

Varieties

MP Chari: The variety matures in 110 days and produces 12 t/acre green fodder and 4 t/acre dry matter yield.

Haryana Chari-260: It is non-sweet, tall, juicy and suitable for karvi making. It is resistant to foliar diseases and have early flowering and maturity. The variety produces 12 t/acre green fodder and 4 t/acre dry matter.

Proagro Chari (SSG-998): It is high tillering, thin stem, leafy, dark green in colour producing 16-18 t/acre of green fodder and 4t/acre of dry matter.

Agronomic Practices

Field Preparation: One deep ploughing with mould board plough should be done in summer followed by 3 to 4 harrowings to maintain weed free conditions

Time and Method of Sowing: Sowing time starts from ending April and continues up to the end of May in sub temperate zones. While in sub-tropical zones, sowing can be extended upto middle of July. It is often sown mixed with legumes like cowpea to provide nutritive feed for milch cattle. The crop should be sown 33 cm apart for seed production and for fodder it should be sown by broadcasting.

Seed Rate: Seed rate varies from 20-24 kg/acre depending upon the method of sowing. Use 12 kg of jowar seed and 12 kg of cowpeas seed per acre when sown mixed.

Manures and Fertilizers: Well rotten FYM @ 3-6 tonnes/acre is applied at least a month before sowing & thoroughly mixed with soil. In addition, 16 kg N (Urea 22 kg/acre) and 16 kg P (DAP-35 kg/acre) are given as basal dose. Top dressing of 8 kg N (Urea-17 kg/acre) is given after 40 days of sowing, followed by irrigation or before rainfall is expected.

Irrigation Water Management: Do not allow the crop to wilt. There should be proper drainage. Water logging is fatal for the crop. Excess water should be drained out immediately.

Mixed Cropping: Jowar can be sown mixed with other crops like cowpeas or moong or mash.

Harvesting: In early stages of growth, Jowar contain HCN which is fatal for cattle. The crop for fodder gets ready in about 80 days and should be cut when lower leaves start yellowing/before the stems get woody or when crop has one half to one third heads emerged. Under irrigated conditions M.P. Charri variety gives 2-3 cuttings.

Yield: Fodder yield varies from 120-140 q/acre. (To avoid wastage, fodder should be chaffed before feeding).

4.6 PIONEER JOWAR

Pioneer Jowar, a hybrid variety is becoming popular among the farmers of Jammu & Kashmir districts. It has an advantage over the other varieties of Jowar having better capability of regenerations. Hence, it is a multi-cut variety and can give 2 to 3 cuts depending upon the efficiency of management. Its cultivation is recommended in sub-tropical areas of Jammu, Kathua, Udhampur & Rajouri districts.

Agronomic Practices

Time and Method of Sowing of Sowing: It can be sown from March to July in the irrigated areas but in un-irrigated areas, it should be sown in the month of July only. Sowing is normally done by broadcasting. In case, seed drill is used, keep a distance of 30 cm from line to line and 10 cm from seed to seed.

Seed Rate: Use 10 to 12 kg of seed/acre.

Manures and Fertilizers: Apply 50 kg DAP and 24 kg urea at the time of sowing and 30 kg urea after each cut/acre.

Harvesting: First cut of green fodder is ready after 40 days of sowing and subsequent cuts can be taken after 25-30 days of the previous cut. In total 2 to 3 cuts of the fodder can be taken. Cuttings of the green fodder should be taken when the plants attain 1 m height and must be 10 cm above the ground level. Being a hybrid variety, fresh seed should be used every year.

Yield: 160-200q/acre

4.7 GUARA

Clusterbean, locally known as guara, is one of the important legume fodder crops in the *kharif* season. Besides, being good it can be used as a green manuring crop. It can be sown in irrigated as well as in unirrigated areas. It is better if the crop is sown mixed with maize, sorghum or bajra fodder. Guara seed can be used as a concentrate for animals.

Soil and Climate: It should be sown in sub-tropical areas of the division. The crop can tolerate the high temperature of May, June very well. It requires moderate humidity. High rainfall increases the incidence of guara leaf blight. Guara can be grown on a wide range of soils, but it does best on well drained deep loamy soils. It is highly sensitive to water logged conditions.

Varieties:

Agaita Guara-111: It provides 9.2 t/hacre of green fodder and 1.8 t/acre dry fodder.

Agronomic Practices

Sowing Time and Method of Sowing: The sowing of the fodder crop starts from the first week of June to the first week of August. In mixtures with chari, maize etc. its sowing can be started from April. Crop grown for seed purpose should be sown in the first half of July. The fodder crop be sown by broadcasting the seed or in rows 30

cm apart and the seed crop in rows 45 cm apart.

Seed Rate: For pure fodder 18-20 kg of seed/acre and for mixed sowing fodder with chari, maize, bajra etc. 10 to 12 kg/acre of seed is recommended. For seed crop 8-10 kg of seed is sufficient for one acre.

Fertilizers and Nutrient Management : It is legume crop, so only a starter dose of 4-9 kg N (Urea-3 to 11kg/acre) to be given. About 8-10 kg of P (DAP 17 to 22 kg/acre) should be drilled before sowing for getting good yields from this crop.

Irrigation Water management: If the rainfall is well distributed, this crop does not need any irrigation. When the rainfall is not sufficient 1-3 irrigations are required. No irrigation be given to the seed crop after 3rd week of September as it delays the maturity of the crop. Surplus rain water should not be allowed to stand in the field.

Harvesting: The harvesting of green fodder may be started as soon as pods begin to form and continued till the pods are fully formed. The harvesting may be started earlier, depending upon the need for green fodder.

Yield: Generally 120-180 q of green fodder/acre is obtained. Good crop raised for seed production can yield 4-5 q of grain per acre.

4.8 TEOSINTE OR MAKCHARI

Teosinte is wild relative of maize. It is leafy succulent with profuse tillering capacity, shows good regeneration after cutting. It is grown for providing green fodder in drier months of May-June and October-November. It is being grown for green fodder or for silage purpose. The crop is best suited to warm humid regions, receiving annual rainfall 100 cm or more. However, it can be grown under drier regions and its yielding potentiality can be exploited only with high fertility and assured irrigation. The crop is more tolerant to insect pests and diseases in comparison to maize or sorghum.

Soil Requirements: Rich well drained soil is required.

Varieties:

Improved Teosinte: The green fodder yield is 14–16t/acre.

TL- 1: It is comparatively taller and has more tillers, leaves and is comparatively 10 days late in maturity than the improved teosinte. It has less incidence of leaf spot disease and green fodder production is 22.5 t/acre and seed yield is 4.2q/acre.

Agronomic Practices

Field Praperation: Deep ploughing is to be given by soil turning plough followed by harrowing and planking.

Manures and Fertilizers: FYM 16 tonnes/acre, N 20 kg (Urea 28 kg/acre) P 16-17 kg (DAP 35 to 37 kg/acre) and K 12-16 (MOP-20 to 27 kg/acre).Apply entire quantity of FYM about 2-3 weeks before sowing. Half quantity of N and entire quantity of P and K are to be placed 7-10 cm below the seed at the time of sowing.The remaining N is to be top dressed in two to three equal splits after each cut.

Time and Method of Sowing: March to August. If line sowing is done than for fodder production 30 cm spacing is required and for seed production 45cm spacing is done.
Seed Rate: 16-20 kg/acre for fodder crop and 8-10 kg/acre for seed production.
Irrigation Water Management: 4-5 irrigations are required.
Harvesting: Ist cutting 60-70 days after sowing & subsequent cut after 80-90 days. For single cut, harvest after tasselling stage. As the crop suffers badly from grain shattering, so harvest, well in time to avoid losses.
Yield: Green fodder: 320 to 400 q/acre Grain: 40 to 48 kg/acre
Mixed Cropping: This crop can be grown mixed with other crops like Teosinte + Cowpea or Moong or Guara.

4.9 DEENANATH GRASS

It is most important annual grass due to its good nutritive value and palatability to all classes of livestock. It is mostly used as a cut fodder, but can also be used as a pasture grass due to its excellent regeneration from self-sown seed. It is adapted to warm climate and can be grown successfully under both rain-fed and irrigated conditions.
Soil: It thrives well on fertile loamy soil with pH range of 6-8, but it can be grown on sandy soils with adequate manuring.
Varieties:
Pusa Deenanath Grass: The maturity period is 120–130 days and average green fodder production is 12–16 t/acre.
Bundel-1: It is a late maturing grass with purple stem. There are abundant long velvet hairs on ventral surface of the leaf. The spike is very large and loose. The large spikelets have long bristles. The variety yields 12–16 t/ha green fodder. The plants have high field resistance to leaf spots.
Bundel-2: This is a late maturing, purple stemmed variety having abundant long velvet hairs on ventral surface of the leaf. It has very large loose spike, large spikelets with long bristles. The variety has potential yield 12–18 t/acre. It has high tolerance to leaf spot, Helminthosporium and other major diseases and insect-pests, is resistance to lodging, drought hardy and is high fertilizer responsive.

Agronomic Practices

Field Preparation: It requires a well prepared moist seed bed. The soil can be prepared by giving first ploughing with soil turning plough followed by 3-4 harrowings.
Seed Rate: A seed rate of 3 kg/acre required depending upon the method and time of sowing.
Time and Method of Sowing: Under irrigated conditions, the sowing of grass can be done from 2nd week of April to ending May. But under rain-fed conditions, the

sowing can be started soon after the commencement of monsoon rain. The seed either be broadcasted or drilled in lines 4-5 cm apart.

Manures and Fertilizers : About 80 q/acre of well rotten FYM is applied one month prior to sowing. 24 kg N (Urea 39 kg), 16 kg P (DAP 35 kg) and 6 kg K (MOP-10 kg) per acre is the optimum dose of fertilizer. Full dose of P & K and 50% of N is applied as a basal dose and rest of N be given in split doses which should be equally applied after each cut.

Irrigation Water Management: During hot summer days. It should be irrigated after every ten days but, during rainy season, it requires no irrigation.

Yield: An average yield of about 120 q/acre of fodder is taken in three cuttings. The first cutting can be taken in about 100 days after sowing under favourable conditions.

Mixed Cropping: It can be grown mixed with cowpeas or mash or Lucerne.

4.10 KAZUNGULA GRASS

It is very important leafy and palatable grass with a fair nutritive value. It can be used well for hay or grazing and is particularly useful because of its good winter growth. It is adaptive to both tropical and sub-tropical and intermediate region can be grown successfully upto an elevation of 1500 m. It can be grown under both rain-fed and irrigated conditions. As rain-fed crop, it is planted in areas receiving 152 cm or above rainfall.

Soil: It thrives well on fertile loam soils, but it can be grown on light soils also.

Varieties:

Nandi: It is fast growing grass suitable for low hills with very good regeneration capacity with dark green leaves and thin stem. The vegetative growth starts during March and remains green till December. It provides fodder during the lean period i.e. May-June and October-November when no other green grass is available. The forage is nutritious and contains 7–8% protein on dry matter basis at 50% flowering. During its growth period, 3–4 cuttings can be obtained with an average yield of 30 t/acre.

PSS 1 (Golden timothy): It is a fast growing perennial grass recommended for cool, frost prone sub-tropical grasslands. It has dark green leaves, medium thick stems and brown rusty head. It remains green for 9-10 months in a year and provides 3–4 cuttings. Green herbage is available during lean periods viz, April- June and October-December. It is drought and cold tolerant. It has yield potential of 22.5 t/acre of green fodder. Its herbage contains low oxalates (2–3%) and high protein (10%).

Setaria 92: The average green fodder yield and dry matter yield is 12.0 t/acre and 3.0 t/acre respectively. It is suitable for cultivation in subtropical grasslands and pastures between 300 and 1400 m above sea level. It is a late maturing variety with very thin tillers, tolerant to drought, cold and frost

Agronomic Practices

Field Preparation: It requires well prepared seed bed. The soil can be prepared by ploughing with soil turning plough followed by 3-4 harrowings.

Seed Rate: The grass is propagated vegetatively through root slips/stem cuttings. About 12000 root slips are required to plant an area of one acre.

Time and Method of Sowing: Under irrigated conditions, the roots are planted from February onwards, but as a rainfed crop, it should be planted on the commencement of monsoon rains. The root slips/stem cuttings should be planted at a distance of 60cm x 60cm.

Mixed Cropping: It can be grown mixed with guara, lucerne, cowpea or velvet beans.

Manures and Fertilizers: 50 to 80 q/ acre of well decomposed FYM/acre should be applied to the field about one week before planting of the grass.

Irrigation Water Management: The crop should be irrigated frequently during hot summer days.

Yield: Under irrigated conditions, the green fodder yield comes about 360q/acre per year in seven cuttings. The first cut will be ready in 80 days from planting and subsequent cutting will be taken at an interval of six to eight weeks.

4.11 SUBABOOL

It is an ever green tree, often called the "miracle tree" grown for improving soil fertility and fodder. It is a deep rooted leguminous plant and a good source of protein for animals. However, it contains a toxic substance called as mimosine, therefore, animals should be fed with mixed forages.

It has tiny flowers that form fluffy white balls. Pods are thin, flat and droop in clusters.

Climate and Soil: It grows best in tropical and sub-tropical areas and is suitable even for rocky steep hills, marginal soils well drained wet areas and dry regions.

Varieties

Hawaiian type: The plants are short bushy and remarkably drought tolerant. It is suited to hilly terrains in drought prone areas. It is a prolific seed producer and is good for fodder purpose**. K-341** is a Hawaiian variety.

Salvador type: Tall, tree like and fast growing having maximum annual biomass production. Possesses large leaves, pods and seeds than Hawaiian types. Responds to high fertilization. **Variety K-8** is useful for fodder.

Agronomic Practices

Field Preparation: The land should be ploughed and harrowed at least once prior to planting. Remove all the weeds and grasses.

Seed Rate: 4 kg/acre

Seed Treatment: In view of the hard seed coat, soak the seed in warm water over night before sowing.

Raising of Nursery: Seedlings can be raised by two ways:
(i) Raising of seedlings in polythene bags. The polythene bags (22.5 x 12.5 cm) are filled with the mixture of soil. FYM and sand in proportion of 1:1:1. The seeds are sown 1 cm deep.
(ii) Raising of seedlings in nursery beds: Seeds are sown in beds, maintaining a distance of 15-20 cm between and 5 to 10 cm within lines.
After Care in Nursery: Regular watering, weeding and hoeing are essential but when seedlings are established, there is no need of watering them.
Time of Planting: February-March and mid June to mid August is the best time for its planting. Six to twelve months old seedlings should be planted at a depth of 45 cm. in case of termite infestation, apply 15 g of chlorpyriphos/pit. Grass seeds or root slips in lines 30 cm apart in the space between the rows of subabol seedlings can be sown/planted.
Planting Distance:

I)	Along the bunds, roads, channels:	2 m x 2 m
II)	Block plantation:	2 m x 1 m
III)	High density plantation:	1 m x 1 m

Note: 25% Subabool leaves be mixed with other fodders for feeding to cattle/ livestock (Avoid feeding of pure subabool).
Manures and Fertilizers : In normal and fertile soils application of fertilizers is not required. However, if the soil is poor, apply super-phosphate @ 5-10g along with 5 kg FYM/pit.
Irrigation Water management: In dry season casual irrigation may be needed. When the trees are established, there is no need of irrigation.
Lopping: For the use of fodder and fuel, plants can be lopped after two years of their growth, leaving the main and thick branches. All the twigs upto thumb thickness is cut by sharp pruning scissors or with dranti.
Yield: 48 -60 q/acre of fodder during 1st year. During 2nd year 20 to 30 q/acre of fodder from subabol alone can be obtained. In closer spacing 100 to 112 quintals of fodder/acre is possible in three to four cuttings.

4.12 GREEN FODDER SUPPLY ROUND THE YEAR

It is necessary to grow fodders throughout the year if full potential of the animals is to be utilized. It is much cheaper to supply nutrients through green fodder rather than through dry stalks and concentrates. Dry stalks mostly paddy straw, wheat straw, maize and bajra stovers are not only low in digestible nutrients but their acceptability by animals is also very low. Their feeding, therefore, necessitates the greatest use of costly concentrates which are beyond the reach of the poor farmer.

In Jammu region, there are two distinct crop seasons *rabi* and *kharif.* During the peak months of fodder growth in *kharif* and *rab*i, there is no dearth of fodder, rather it

is in excess. Berseem and oat fodders are in abundance from January to April. But from May upto middle of July, most of the farmers have to carry on with only limited green fodder and hence use concentrates along with poor quality wheat bhusa to feed their animals. Again from mid July to September, green fodder is in plenty from the cultivated fodder crops like sorghum, cowpeas, grasses and weeds from the cropped fields. But again in October to December, fodder deficiency is faced when the *kharif* fodder are over and *rabi* fodders have not yet made sufficient growth to be available for harvesting. So, in between the two major fodder supplying periods, there are two distinct lean periods for fodder supply I) May to mid July II) October to December. Therefore, green fodder supply throughout the year is actually planning green fodder supply during two scarcity period in a year, which can be arranged by planning crop rotations to grow fodders for these periods. Following crops and crop mixtures are recommended for sowing for supply of fodders during two lean periods.

A. Fodders for summer lean period:

S.No.	Name of the fodder	Time of sowing	Situation where to grow	Fodder supply period
1.	Maize + Cowpea MP Charri + Cowpea Cowpeas alone	Mid March onward at two weeks interval	In the field vacated by potato vegetables, sarson and fields otherwise left fallow in rabi	Mid May to Mid July if sowing has been done in intervals
2.	Maize + Cowpea, MP Charri + Cowpea, Bajra + Cowpea, Cowpeas alone	Mid April	In the fields vacated after early harvesting of wheat crop.	June -July
3.	Hybrid Napier/Steria grass	July-August (previous year)	Perennial harvesting should be planned so as to provide green fodder during lean period.	Mid May onwards
4.	Lucerne	Oct-Nov.	-do-	Mid May to June

B. Pre-winter lean period:

S.No.	Name of the fodder	Time of sowing	Situation where to grow	Fodder supply period
1.	MP Charri + Cowpea	Mid July	Late sowings recommended	Sept.-Oct.
2.	MP Charri seed crop	-do-	After picking seeds from standing crops.	Oct.-Nov.
3.	Teosinte + Cowpea	Early July	Suited both for	Oct.- Nov.

			irrigated & rain fed areas.	
4.	Deenanath grass	Early July	Suited even for rainfed areas.	Oct.- Nov.
5.	Hybrid Napier/Steria grass	July-August (previous year)	Perennial harvesting should be planned so as to provide green fodder during lean period.	Oct.- Nov.
6.	Lucerne	Oct.-Nov. (previous year)	-do-	October onwards
7.	Turnip + Fodder, Rape berseem + Fodder, Rape Berseen + Oat	September	Fields vacated earlier from kharif crops.	Nov.-Dec.

4.13 GRASS/PASTURE MANAGEMENT

Grassland has been considered to be a naturally vegetated, vast stretch of unfenced land grazed by domestic livestock and game animals and dominated by graminaceous plants. Pasturing in grassland is cheaper since practically all the expenses on growing, cutting transporting of forage is eliminated in case of in situ grazing. The main objective in the management of grass lands is to secure the maximum production of livestock without any detrimental effect on the productivity of the grasslands. The problem of the grasslands in Jammu division is that they have been depleted and deteriorated due to indiscriminate cutting of grass, uncontrolled grazing, over-stocking, lack of fertilization, lack of legume component and infestation with weeds. Due to over grazing, the vegetative cover has been lost and it has encouraged the soil erosion. The following methods are suggested for rejuvenating these depleted grasslands.

A) **Fencing:** In the scientific management of grassland, the first step is to enclose the grassland area, so that the finer species of grasses which were lost by over grazing come up again due to plant succession. Simultaneously, seeding of superior grasses and legumes should be taken up. Fencing helps to regenerate, stabilize growth and compete with local flora, so that a rangeland is converted into productive grassland. The protection is quite effective through the local practice by enclosing the area with cut rank vegetation. Bushy and spiny branches and other material collected from the area may be used as boundaries.

In case sufficient bushy material is not available in the degraded/denuded rangeland, live fencing of available species such as Parkinsonia, Opuntia, lpomea, Lantana, Su-babool and Euphorbia etc. need to be established. However, in the initial

stage barbed wire fencing with wooden poles may be provided. All the undesirable bushes, shrubs and rank vegetation should be removed through manual felling at the ground level.

B) **Reseeding of Grasslands with Improved Varieties:** Since the natural processes of succession, migration and ecosis of perennial species is time consuming, therefore, introduction of better varieties of grasses, legumes, climbers, bushes and fodder trees is necessary for quick establishment of grasses to meet the required nutrition of the livestock. Selection of the grasses and legumes to be seeded depends upon the agro climatic conditions and soil type of the area. Seed rate should be kept 1-2 kg/acre of each grass and legume species. For grass alone 2-3 kg/acre of seed is sufficient. Seed can be sown after tillage of the area or by pit method at a spacing of 50 cm and at depth not more than 1.25 cm. If broadcasting method is used, working of soil with rake etc. in the surface is required. Each line of legume seed should be alternated with two lines of grass seed. However, in case of napier and setaria, rooted slips should be planted in natural grassland at a distance 1.5 m x 0.75 m, so that in the intervening space, natural grasses may also grow side by side. This will also help in mixed feeding of grasses to animals as feeding with pure napier is not advisable due to oxalate content in it.

Sufficient preliminary information should be gathered on the choice of species to be sown, the quality Zones. The grasses legume and fodder tree species recommended for different elevations is given below:

S.No.	Elevation	Grasses	Legumes	Fodder trees
1.	300-500 m	Dinanath grass, Cenchrus, Dichanthium, Anjan grass		Su-babool, Siris (Albizia lebbeck), Dhamman, Khair, Albizia, Bamboo etc.
2.	500-1000 m	Cenchrus, Dichanthium, Deenanath, Napier, Seteria	Dolichos lablab,Stylosanthes hamata, Red clover	Dhamman, Siris, Bamboo, Quercus, Salix, Mulberry, Albizia
3.	1000-2000 m	Chrysopogon, Cenchrus, Cymbopogon, Themeda, Lolium etc.	Stylosanthes, Kudzuvine	Quercus, Wild fig, Salix, Mulberry, Rubinia etc.
4.	Above 2000 m	Cock's foot, Bromus festuca, Lolium, Tall Fescue	Red Clover, White Clover, vetches	Rubinia, Salix, Quercus etc.

C) **Fertilization of the Grassland:** It is equally important that grasslands should be applied fertilizers. The yield of the forage is increased 2 to 3 times by simply fertilizing the grassland. The dose should be kept at 16 to 24 kg N (Urea 28 to 39 kg)

and 8 to 16 kg P_2O_5 (DAP 17 to 35 kg) per acre. The right time of fertilizer is middle of July in sub-tropical and in February as well in temperate area.

D) **Rotational Grazing/Stall Feeding:** It is an important factor in grassland management. The greatest single factor, which causes deterioration of grasslands is overgrazing. Rotational grazing should be practiced in the pastures. The idea behind the rotational grazing is that when over-grazed pastures are protected from frequent grazing, the productive perennial type quality grasses replace the undesirable annual grasses, weeds, bushes and shrubs. Otherwise, the perennial types hardly get a chance to establish and therefore are unable to compete the annual vigorous types. In well managed grassland, grazing should be avoided and stall feeding should be encouraged. The yield of harvested grassland will be much higher than the grass biomass provided to grazing animals, since most of the grasses are damaged by the trampling by the animals. However, for rotational grazing, it is suggested that grassland should be divided into three parts. In one part, grazing should be allowed only after seed have ripened and fallen down. Before it's grazing is allowed in two other parts. The practice of rotational grazing is followed so that each part of the grassland gets the chance of seed shedding after every two years.

Weed Management Strategies

Lantana weed can be controlled by cutting the bushes near ground level in April month followed by glyphosate spray @ 1% in June month. For providing the cover crop, the pasture land may planted with *Napier* or *Setaria* slips to cover the regrowth of Lantana.

Parthenium can be controlled by application of either 2, 4-D @ 0.6% or glyphosate @ 1% on the newly emerging tender growth. Hybrid *Napier* or *Setaria* slips planted in July-Aug. provide smothering effect. Spot treatment of above herbicides may be repeated in Oct. -Nov. followed by gap filling of these rooted slips.

Saccharum weed after its first cut from ground level during Dec. - Jan. need spray of 0.75% glyphosate during May-June followed by planting of *Napier* or *Cenchrus* slips during rainy season.

4.14 SILAGE MAKING

Silage is the product formed when any green plant material is put where it can ferment in the absence of air. In this process of fermentation, the silage develops some acid which preserve the nutrient substances in the plant material. This fermentation is complete in first two or three months. The process of making silage is known as ensiling.

Advantages of Silage Making

1. Surplus fodder can successfully be conserved into more acceptable, digestible and laxative form than if the fodder is converted into dry fodders. The carotene,

precursor of vitamin A is better preserved in silage than in hay.

2. Silage is an insurance against fodder shortage during scarcity periods.
3. The botheration of daily harvesting and chaffing is eliminated. Harvesting of green fodder can also be adjusted so as to obtain maximum digestible nutrients from a crop.
4. The fields get vacated in a couple of days and become available for timely sowing of the next crop.

Crops Suitable for Silage: Fodder crops which contain a high percentage of carbohydrates are ideal for silage. Maize, Jowar, Bajra, Napier and Steria grasses are good for silage. Leguminous crops like Cowpeas, Guara, Lucerne and Berseem fodder can also be converted into silage. Cereal and Legume mixture in 50:50 ratio is a good silage. Stage at which the crop is to be cut for silage is important for making good quality silage. Optimum stage of maturity for cutting any crop for silage is that when they have maximum digestible nutrients. For each crop, stages are given as under:

Crop	**Stage of Harvest**
Maize	Milk-ripe or soft dough stage
Jowar and Barley	When one third to one half heads appear
Oats and Barley	Milk stage
Legumes like Cowpeas, Lucerne and Berseem	Pre-flowering stage

A crop with 30-35 percent dry matter ferments into a high quality silage. If dry matter content is low, let the crop wilt in the field for one or two days.

Preparation of SILO: Different types of silo are used for silage making depending upon conditions of soil, water table, economic consideration, quantity of silage required etc. Trench silo, Bunker silo, Pit silo, Tower silo are some of the kinds of silo. However, use of trench silo is recommended for Jammu area. The detail of trench silo is given as under:

Select a high level spot and prepare a bricked and cement plastered silo trench 10 meters long, 8 meters wide and 2 meters deep. About 300 to 400 quintals of chaffed green fodder can be packed in this trench. It can supply silage for 10 dairy animals for four months at the rate of 20 to 30 kg per head per day. The dimensions of the silo trench can be adjusted depending upon the quality of green fodder to be ensiled.

Filling the SILO:

1. Chop the harvested crop and pack it into the silo trench, it is best done when a tractor is run over the chopped fodder. Fill the trench upto about 1 metre above the

ground.

2. Cover it with a layer of 10 to 15 cm thick of rice straw or wheat bhusa. Cover the straw layer with moist earth and then mud plaster layer. Ensure that the silo trench is completely air tight. Alternatively, before filling, polythene sheet of the grade 100μ to 200μ used to cover grain bags, may be spread on the sides on the trench, keeping enough extra length to cover and overlap the top of the packed material. This reduces the some weights etc. after covering. This reduces the spoilage losses of the silage to minimum.

3. Keep an occasional watch and if there is any crack or hole, plug it immediately. Silage will be ready for feeding after 45 days.

I) **Chemical Changes in Silage:** When the green cropped forage is first stored in a compact mass in a silo, the living plant cell continue to respire, thus rapidly using up the oxygen of the trapped air and giving off Carbon dioxide. In about 4-5 hours, the free oxygen is all used up, percentage of Carbon dioxide increase rapidly for about 48 hours, when it comprises from 60 to 70 percent of the silo gases after the Oxygen is used up and molds do not develop.

II) **Temperature Increase:** If the air is excluded, the increase in temperature is not great, it will be 800 to 850 ◦ F near the bottom and about 1000 ◦ F near the top. But if the air gets into silage, the temperatures may rise to 1300 ◦ F. The increase in temperature is caused due to bacterial fermentation. The temperature continues to increase for about 15 days and then gradually decreases.

III) **Increase in Bacterial Population:** The conditions of growth in the silage are excellent for the lactic acid bacteria and their number increases rapidly. These bacteria or enzymes attach the sugar and other food material breaking them down into organic acids like lactic acid, acetic acid and butyric acid and also some ethyl alcohol.

IV) **Increase in Acidity:** When the acid in the silage has increased to a certain degree bacteria ceases to multiply with the result that no more acid is developed. The kind and amount of acids that develop depends largely on the kind of crop, especially on its sugar content. When the fodder crop contains sufficient sugar, anaerobic lactic bacteria become active to produce good, clean smelling silage of high quality. It is thus essential that forage used for silage should have a high percentage of carbohydrates. But if the forge is too rich in proteinaceous substances, the rich butyric acid is one of the acid type fermentation will pre-dominate. This fermentation is also anaerobic but butyric acid is one of the main products of this fermentation. Butyric acid has a sharp; disagreeable odour and the silage is not relished by animals. In these cases, preservative such as molasses @ 1 kg per 100 kg of green material may be used to improve upon the quality. Wilting the green material to a moisture content of 65 percent is also effective in bringing down the

butyric acid.

Characteristics of Good Silage: Good silage should have a mild, pleasant aroma, sour taste and slightly greenish colour. It should be free from slimes and moulds and have sufficient acid to prevent further action of micro-organisms.

Causes for Poor Silage:

1. **Not enough acid:** When the forage does not develop sufficient acid to stop the fermentation, undesirable bacteria cause rotting. Such bacteria produce enzymes that break down some of the protein, causing an off-flavour and slimy silage.

2. **Too much acid:** When forage crops with exceptionally high sugar content such as immature maize or Jowar are used, the acid may be so high that a sour, unpalatable silage may result.

3. **Not enough moisture:** When the moisture in the forage is not enough, the silage will not pack well and air will be left in the silage. Moulds develop in such conditions when the silage contains too much moisture, the silage is likely to be too sour. High moisture causes undesirable fermentation to take place.

Opening of SILO: Silage should be taken out in section, exposing only a small surface at a time. It should be opened in vertical section and remove the daily requirement of the silage right upto bottom. The exposed portion as far as possible be kept covered.

Feeding the Silage: For first few days animals may dislike its taste. Help them to develop the taste by mixing 5 to 10 kg of silage in their green fodder ration for first 5-6 days. After the taste has developed, 20 to 30 kg of silage alongwith other fodders may be fed per head per day. Silage may produce some flavor which may be carried over in the milk, especially, when fed just before or during milking. So feed the silage after milking to the milch cattle. Spoiled silage should not be fed as there is a danger of causing digestible disturbances.

5. CASH CROPS

5.1 SUGARCANE

Sugarcane is cultivated to very limited extent in Jammu division in the districts of Jammu and Kathua. However, there is scope for increasing the area under this crop in these districts.

Climate: Sugarcane successfully grows both under sub-tropical and tropical conditions. It requires long sunny days synchronizing with sufficient amount of water and optimum temperature over longer seasonal period (10-12 months), Temperature above 46°C enhances its growth and that below 20°C slows down its growth. Low temperature reduces tillering. The temperature range between 25-35°C is found suitable for its best growth. The crop does well in the regions having rainfall from 750 to 1200 mm annually.

Soil : Sugarcane can be grown on all types of soils ranging from sandy loam to clay loam in texture, provided they are well drained. However, its best growth occurs on loamy soils.

Varieties: The following high yielding varieties of sugarcane are recommended for cultivation: COJ-64, COJ-81, COJ-77, COJ-67, COJ-72, CO-1148 and CO-1158

Agronomic Practices

Field Preparation: Sugarcane requires deep tillage for good development of root system. One deep ploughing with a soil turning plough (Tawi plough) followed by 2-3 cross harrowing with a disc harrow or 5-6 ploughing with a desi plough will make the soil suitable for sugarcane planting, ploughing should be done to make the field smooth and clod-free.

Seed Selection: Healthy seed material taken from 10-12 month old crop and free from pests and diseases should be selected for planting. The top one third to half portion of the cane being comparatively immature has buds of high viability and best suited for seed purpose as it germinates faster. Before planting, the dry leaves of the cane stalks are removed by hand and, thereafter, the cane is cut into 3 budded setts usually 30-45 cm in length.

Seed Rate About 12000-16000 setts are sufficient to plant one acre (3.75-4.0 quintal by weight).

Seed Treatment: Sugarcane setts when treated against pests and diseases result in good germination and healthy canes, and bring higher yield.

Higher Germination:

a) Soaking in cold water: Soak the canes to be used for seed material in cold water for 12 hours. This results in about 15% higher germination.

b) Hot Water Treatment: Soak setts in hot water (52°C) for 5-7 minutes. This treatment helps in converting sucrose into glucose and sprouting of relatively large number of buds takes place.

Time of Planting: March is the best time for planting.

Method of Planting

1. **Flat planting** method is suitable for sugarcane planting in the sub-tropical regions of Jammu. Shallow (8-10 cm deep) furrows are opened with a desi plough or cultivator at a distance of 75 cm. The setts are planted in them end to end. After that furrows are covered with 5-7 cm of soil and field is levelled by a planker.
2. **Ring pit planting** method has been found more remunerative. The pit of 90cm diameter having depth of 45 cm is being dug with a gap of 60 cm between the two adjacent pits .At this spacing, the pits are placed at 150 cm apart. The pits are filled with loose soil and FYM to a depth of 15 cm and between two budded setts dipped in 0.3% solution of copper oxychloride for 30 minutes are planted in these rings to get profitable yield.

Rotations

1. Maize-Potato-Sugarcane 2 years
2. Paddy-Toria-Sugarcane 2 years
3. Paddy-Potato-Sugarcane 2 years
4. Barseem fodder-Sugarcane-Ratoon 2 years

Intercropping

I) Sugarcane + Moong (Sugarcane row: 90 cm apart and 2 rows of moong 30 cm apart as Intercrop).

II) Sugarcane + Urd

III) Sugarcane + Cowpea

Fertilizers and Nutrient Management: Sugarcane is a heavy feeder of nutrients, 20 tonnes of FYM or compost/acre should be incorporated in the field at least 15 days before planting of sets. For efficient use of chemical fertilizer, the farmers must get their soil samples tested well in advance. However, in absence of soil test, the following fertilizer schedule is recommended in case FYM is not available:

Nutrient (kg/acre)			**Fertilizer (kg/acre)**		
N	**P**	**K**	**Urea**	**DAP**	**MOP**
60	30	30	106	66	50

Apply ½ of N dose and total P and K at planting. Remaining N be applied in two split dose i.e. 1/4th at the beginning of tillering phase in June and the rest 1/4th at the end of grand growth phase in July and August.

Irrigation and Water Management: Irrigation in sugarcane depends upon the

climate conditions, type of soil and cultural practices. The soil must have sufficient moisture at time of sowing. First irrigation should be done when about 20-25% plants have germinated or about 20 days after sowing. Subsequent irrigations are given at an interval of 10-15 days during summer and 25-30 days during winter. If the monsoon is not favourable, the crop has to be irrigated during the rainy season as and when needed. The crop needs maximum water at tillering stage and during elongation or grand growth stage. Thus 10-12 irrigations are required for obtaining a good crop. Proper drainage is essential especially in water logged areas as it not only increases the cane yield but also the sucrose content in the juice.

Interculture: First hoeing (blind hoeing) is done one week after sowing in order to break hard crust and cover the exposed setts properly. The second hoeing is undertaken 3 weeks after sowing and subsequent hoeing should be done after every irrigation before tillering starts. The first earthing is done in end of May to mid June and the second around mid August. Then the ridges are made in the inter row space.

Weed Management: The most critical period for weed competition in sugarcane is the 4 months period after sowing as beyond which the growth of weeds is suppressed due to smothering effect. However, weeds can effectively be controlled by spraying 1.6 kg/acre of Atrazine in 200-240 litres of water 3 days after planting, light irrigation after germination helps in increasing efficiency of these herbicides.

Tying, Wrapping & Propping: Tying should be done in August when cane reaches a height of 2 metre. The dried leaves are removed from the plants. Covers are wrapped together into a bundle with the help of green leaves. After wrapping, the clumps in the adjacent rows are tied together (cross-wise). These clumps are further supported by bamboo poles from outside the field.

Harvesting: The crop matures within 10-12 months after planting. The following symptoms should be observed before harvesting the crop.

1. Leaves turn yellow, plants stop growing and arrows are formed.
2. Canes become brittle and break easily from the node with a metallic sound.
3. The buds swell out at nodes.

Ratoon Crop: Ratoon is a crop which is allowed to grow in the same field from the roots of the previous crop without planting new seed setts. Only one ratoon should be taken and the succeeding ratoons become carrier of diseases/pests. Harvest the main crop in February by cutting the canes close to the ground surface, irrigate the field after harvesting and subsequent irrigations can be applied as and when required. 'N' requirement of ratoon crop is 20% more than the crop raised from setts. Apply ½ of N dose and total P and K after irrigation and remaining N in July. Other operations are same as in the planted crop. Ratoon crop matures earlier than the planted crop and, therefore, its harvesting should be undertaken earlier.

Plant Protection

I. Major Insect Pest and their Management

a) **Pests:** Application of chlorpyriphos 20 EC (2 ml/L of water or 480 ml/acre in 240 L of water over the setts in furrows at the time of planting to prevent attack of termites.

b) For control of borers, spray the crop with cartap hydrochloride 4 G @ 10 kg/acre.

II. Major Diseases and their Management

Name of Disease and symptoms of attack	Control measures
Red rot (*Collectotrichum falcatum*): The symptoms on leaf consist of small elliptical; blood red spots on midribs that quickly elongate and coalesce into lesions that may extend the entire length on leaf. Characteristics band of clear white areas run transversely across the full breadths of the reddened pith.	1. Select the healthy sugarcane setts. 2. Grow resistant varieties recommended for the particular area. 3. Dip the setts in triademefron @ 0.05% solution for 15 minutes before planting. 4. Do not ratoon the diseased crop. 5. Long crop rotation should be followed.
Grassy shoot or Albino disease (*Phytoplasmas*): The disease is characterized by production of numerous tillers from the base of the affected stool that gives appearance of bunch of grassy stool with pale yellow or chlorotic and small thin narrow leaves.	1. Grow resistant varieties. 2. Uproot and destroy the affected clumps promptly. 3. Do not ratoon the diseased clumps. 4. Use seed of healthy field. 5. Spray of dimethoate @ 1.5 ml/L of water 2-3 times at 15 days interval to avoid the disease spread.
Ratoon stunting (*Riketessia like organism*): The affected crops remain stunted with short and thin canes. A yellow orange, pink red or reddish brown discoloration occurs with individual vascular bundles in the nodes of mature canes.	1. Grow resistant varieties. 2. Plan setts only for healthy canes. 3. Do not ratoon the diseased plants.

5.2 SAFFRON

Saffron plays an important role in economy of Union Terrotoory (UT) of Jammu and Kashmir. It is grown in an area of about 9462 acre with an estimated annual production of 9.46 MT. The crop is grown in the temperate regions of the Kashmir Valley and Kishtwar tehsil of Jammu region.

For obtaining optimum production of saffron, the following improved practices are recommended.

Soil Requirement: It requires well drained clay loam soils free from pebbles.

Agronomic Practices

Field Preparation: The land should be ploughed upto a depth of 25-30 cm and subsequently, debris of perennial weeds which are uprooted during the ploughing

operations, should be collected and removed from the field. The field should be thoroughly leveled filling in all depressions to avoid stagnation of water.

Time of Planting: First fortnight of August

Planting Stock: Saffron is planted by corms. Select disease free and large sized corms, having at least 2.5 cm diameter having weight greater than 10g. The husk dirt etc. adhering to the corms and outer tunic layer should be removed, and the corms before planting should be treated with a carbendazim @ 2gm/kg.

Seed Rate: About 20-24 q corms are required to establish one acre area.

Method of Planting: Raised bed cultivation should be followed with the spacing of row to row 15 cm and corm to corm 10 cm and the corms should be placed at a depth of 10 cm.

Fertilizers and Nutrient Management: Yield of saffron is increased when chemical fertilizers in a balanced form and in moderate doses are applied. The following doses of different fertilizers are recommended to increase the yield of saffron under the rainfed conditions:

Nutrient (kg/acre)			Fertilizer (kg/acre)		
N	**P**	**K**	**Urea**	**DAP**	**MOP**
8	11	7	8	24	13

Urea should be top dressed in the crop during the winter season (December-January). Diammonium Phosphate (DAP) and Murate of potash (MOP) should be applied in the month of September with the last intercultural operation.

Interculture: Interculture in saffron is very essential. It is done during the summer season when the corms are resting in the soil in dormant state. During this period, at least three intercultures may be done to remove weeds, mixing of dry leaves in soil and to create soil mulch for conservation of moisture.

Yield: The yield of saffron during the four years is 2.4-3.2 kg/acre (0.6-0.8 kg/acre saffron per annum). The average yield during the first year of planting is the lowest.

Plant Protection

I. Major Insect Pests and their Management

For eradication of rats, their holes should be fumigated with Aluminium phosphide tablets. Poision baiting with 2% zinc phosphide–bromadiolone baiting is also effective. Community approach is advocated for rodent management.

II. **Major Diseases and their Management:** Corm rot is the major constraint in the cultivation of saffron. The disease is mainly caused by *Fusarium oxysporum* f. sp. gladioli. The disease can be managed by adopting following measures:

i) Deep ploughing of fields in summer months.

ii) Planting in raised beds with proper drainage.

iii) Use of healthy and disease-free corms.

iv) Use soil amendments such as well decomposed farm yard manure (FYM) @ 8 t/acre

v) Augmentation of FYM with bio-control agent (*Trichoderma* spp. @ 1 kg with 20 kg FYM) for soil application for one acre.

vi) Corm treatment with copper oxychloride @ 0.3% or by dipping the corms in copper oxycloride (3 g/litre of water) solution for 30 min. before sowing.

vii) Field sanitation by collecting and burning infected plants including corms.

6. MILKY MUSHROOM (*Calocybe indica*)

Milky mushroom (*Calocybe indica*) popularly known as *Doodhiya* mushroom because of its milky white colour is an excellent edible mushroom with high fiber. It can be grown on a wide range of substrates such as straw of paddy, wheat, ragi, maize, bajra sugarcane bagasse, dehulled maize cobs etc. However, cereal straw (paddy/wheat) is generally easily available in abundance and is so widely used for its cultivation. Only fresh and dry substrate should be used for cultivation of milky mushroom. Substrates exposed to rain or harvested premature (green color) are prone to various weed moulds which may result in failure of the crop.

Preparation of Substrates: Wheat/Paddy straw is chopped in small pieces (2-4cm size) either manually or mechanically by paddy straw cutter and soaked in water for 6-8 hours to make it completely saturated with water.

Pasteurization: This can be achieved in either of the two ways:

Hot Water Treatment: Water is boiled in wide mouth container and chopped wet straw is filled in gunny bags is submersed in hot water for 40 minutes at 80-90^{o}C to achieve pasteurization. Care should be taken that after submersing the straw the water should boil for at least 40 minutes. Thereafter the straw is taken out from the hot water and spread on a pucca floor. Before spreading, the floor should be disinfected with a solution of 2% formalin. After leaching of excess water, the moisture percentage of straw should be 65-70%. This straw is ready for spawning. This is a very popular method particularly with small growers.

Sterilization: Substrate is filled in polypropylene bags (capacity of holding 2-3 kg wet substrate) and sterilized in autoclave at 15 lb psi for 1 hour.

Spawning and Spawn Running: Spawn dose of 4-5% of wet substrate is used for spawning. Fresh good quality spawn procured from some reliable agency should be used for spawning. After spawning, the bags are shifted to cropping room and kept in dark where temperature of 25-35^{o}C and relative humidity above 80% are maintained. It takes about 20 days for the straw in bags to get fully colonized. Thereafter the bags are ready for casing.

Casing: Casing means covering the top surface of bags after spawn run is over, with pasteurized casing material in thickness of about 2-3cm. Casing provides physical support, moisture and allows gases to escape from the substrate. Casing material (soil 75% + sand 25%) with pH adjusted to 7.8-7.9 with chalk powder is pasteurized in autoclave at 15 1b psi for one hour or chemically treated with formaldehyde sol. (4%) about a week in advance of casing. Solution should be enough to saturate the soil. It is covered with polythene sheet to avoid escape of chemical and at an interval of 2 days soil is turned so that at the time of casing soil is free from formalin fumes.

Casing material is spread in uniform layer of 2-3 cm thickness. Temperature of 30-35°C and R.H. of 80-90% are to be maintained.

Cropping: It takes about 10 days for mycelium to reach on top of casing layer. At that time fresh air is introduced while maintaining temperature of 30-35°C and R.H. of 80-90%. Light should be provided for long time. The changes thus made in environment, result in the initiation of fruiting bodies within next 3-5 days in the form of small needle shaped fruit bodies which mature in about a week time. When the pileus of milky mushroom attains 7-8cm dia., these are harvested by twisting. After cleaning, the mushrooms are packed in perforated polythene / polypropylene bags for marketing. Mushrooms can also be wrapped in kiln film for longer storage.

Biological Efficiency: Potential biological efficiency of this mushroom is 50-100% i.e. from every 1 Kg. of straw one can harvest 500 grams to 1 Kg. of fresh mushrooms.

Shelf Life: It has a shelf life of 2-3 days at 25-30°C and 10-15 days at 4°C. It can be marketed as fresh, dry or as mushroom powder. It is ideal for preparation of pickles.

Spent Mushroom Substrate: After harvest of mushrooms, the spent mushroom substrate can be used as excellent organic manure or for vermicomposting.

Precautions to be observed:

a) During the spawn run stage, keep the cropping room dark so that spawn running is achieved fast.

b) Periodically place Rat-baiting to kill rats as they are attracted to the spawn.

c) Periodically sprinkle water on sand layer to maintain the required conditions of humidity.

d) Avoid spraying any insecticide or fungicide on the mushroom beds.

7. 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 practices 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 pest 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:

1. Apiary ground should be clean & free from dry leaves etc. to avoid fire during summer
2. Apiary site should be away from power station brick kilns highway and train tracks
3. Site should be open & at dry place having shade and easily accessible by road.
4. Fresh running water should be easily available near the apiary and have natural/artificial wind breaks.
5. Site should receive early morning and afternoon sunshine.
6. Area should be rich in bee flora.
7. 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 the cases depends on quality of bees particularly 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

A. 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.

B. 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 300C
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.
xi. **Provision of fresh water in the apiary**
xii. Ensure availability of fresh water preferably in shallow containers near the apiary to maintain a healthy apiary. Water is needed for the following
xiii. Maintenance of adequate humidity in a colony to ensure proper incubation of eggs.
xiv. For feeding bee bread by nurse bees the mixture of honey and pollen of certain consistency is required for which water is needed.
xv. When temperature in the apiary increases beyond 370C water is used by bees to evaporate and cool the colony.

C. 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.

D. 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:

E. Care during migration

i. Migrate colonies during non-availability of flora to areas with abundant flora.

ii. Before migration survey the area to assess the availability of the flora to locate the colonies

iii. Ensure honey extraction before migration.

iv. Close the entrance gates of the colonies in the evening after all the worker bees are inside the colony

v. Pack the colonies internally and externally before migration to avoid jerking.

vi. Colonies in the vehicle should be packed in such a way that the entrance side should face the front side of the vehicle.

vii. Start migration late in the evening and ensure the colonies reach the destination within 10-12 hrs. the next day morning and entrance gates are opened after landing in the new location.

viii. 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.

ix. 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	February -April	*Brassica sp., Trifolium sp., Robinia pseudoacacia, Prunus, Rosa, Acacia, Rubus*

Rajouri districts)		
	May - June	*Acacia, Brassica, Raphanus, Fagopyrum, Acacia sp.*
	July - August	*Zea, Trifolium, Indigofera, Helianthus, Plectranthus*
	September - October	*Zea, Trifolium, Helianthus*
	November - December	*Crocus*
Lower hills (parts of Doda, Ramban, Banihal, Kishtwar Udhampur, Poonch and Rajouri districts)	January - February	*Salvia, Salix, Viburnum, Rosa*
	October-March	*Isodon rugosus*, *Brassica campestris*, *Wendlandia*, Toon
	October-December	*Brassica campestris* var. *toria*, *Eucalyptus*
	November-May	Litchi, berseem, sunflower
	April-June	*Litchi*, *Citrus*, *Prunus*, *Acacia*, cucurbits, *Adhatoda vasica*, *Pyrus, Rosa, Rubus sp.*
	July - August	*Trifolium, Medicago, Plectranthus, Dianthus*
	August - October	*Zizyphus*, Maize, *Brassica, Trifolium, Olea sp.*
	February-March	*Brassica* sp., *Eucalyptus*, shisham, drumstick
	December-March	*Brassica* sp., *Eucalyptus*, coriander, Fennel,
	March-May	Jamun, *Indigofera, Allium*
Plains (Jammu, Samba parts of Kathua and Udhampur))	January - March	*Brassica, Mangifera, Wendlandia*
	March - April	*Brassica, Cassia, Citrus, Dalbergia, Mangifera,*
	May - June	*Dalbergia, Zizyphus, Cassia, Acacia, Grewia*
	July - August	*Acacia, Zizyphus, Grewia*
	September - October	*Sesamum, Zea, Acacia, Zizyphus*
	November - December	*Brassica, Bauhinia*

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
Within 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

F. 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.

G. 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 donot 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.

H. 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/ pinapple/sweet candy

***Varroa destructor* Management**

- The infestation is caused by an ectoparasitic mite (Vararoa 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* ***Division of Entomology, FoA, SKUAST-J, Main campus Chatha, Jammu.

8. Integrated Farming System Model

Integrated Farming System approach is a complex inter-related set of elements containing crops, horticulture, dairy, poultry, fishery, sericulture, vermicompost, sheep/goat, farm forestry, etc. which are inter dependent and complementary to each other. In addition, Integrated Farming System is a resource management strategy to achieve economic and sustained agricultural production to meet diverse requirement of the farm household while preserving the resources base and maintaining high environment quality.

The SKUAST-Jammu has developed the Integrated Farming System model of 20 kanal (1.0 ha) area for small and marginal farmer on its farm to study the synergistic of various components of farming. The farming system modules developed comprises of cropping system (viz. rice-wheat-green manuring, rice-potato-black gram, rice-mustard-fodder and berseem+oat-maize+sorghum with hybrid Napier on bunds) in 09 kanal + Horticulture (Guava as main crop, lemon and mango cv Amarpali as boundary plantation) and broccoli, knoll khol, cabbage, cauliflower and okra as intercrop in 7.4 kanal + Dairy (2 cows HF + 1 buffalo Murrah) including Biogas (2m3) and Vermicompost Unit in 1.6 kanal + Fish cum Poultry in 2.0 kanal + Mushroom (Button and Dhingri) in 0.4 kanal (Table-1).

On the basis of long term research, the economic analysis, area distribution with regard to each component comprising on 20 kanal farm land has been standardized as under (Table-1).

Table 1: Component wise land allocation, expenditure, gross income and net profit

Component	Net Area (kanal)	Gross Return (Rs)	Total cost (Rs/ha)	Net return (Rs)
Crop unit				
Cropping system	7.6	61671	37420	24241
Horticulture unit				
Fruit crops	6.0	17709	6195	11514
Vegetables (intercrop)	-	31163	15663	15500
Floriculture	1.4	5365	1445	3920
Agro-forestry	-	1507	299	1209
Livestock unit				
Dairy animals (including vermicompost)	1.6	342770	192895	149875
Bio gas		15870	7380	8490
Fish cum poultry unit				
Poultry/Ducks	-	60201	25857	24343
Fisheries	2.0	29829	9129	20700

Apiary unit (03 boxes)	-	3750	2150	1600
Green fodder*	1.4	13421	2781	10640
Mushroom unit (6 q wheat straw)	0.4	33583	10904	22681
Grand total	**20.4**	**616839**	**312131**	**304713**
The profit is quite comparable to existing farming system, which works out to be 0.80-0.90 lakh/ha.				

***** Fodder-fodder cropping system and on bundsplanted perennial fodder crops (Hybrid napier)

Table 2: Month wise cost of production, gross return, net return and employment generation under IFS model of 20 kanals

Month	Total cost involved (Rs)	Gross return (Rs)	Net return (Rs)	Employment generated (Man days)
July	27132	48892	21760	46.25
August	26658	48634	21975	47.75
September	24103	27376	3273	41.75
October	24994	32467	7473	60.75
November	20287	23077	2790	49.5
December	25857	47787	21930	48
January	34653	67778	33125	54
February	28201	56295	28095	48
March	24689	74300	49612	50.75
April	19801	33518	13717	42
May	23408	60254	36846	62.25
June	28656	88526	59870	44
Total	**308439**	**608904**	**300466**	**595**

It is evident from the above long term study of IFS that there is having the potential not only to increase the profit to Rs. 3.05 lakh/year/20 kanal which is quite comparable to existing rice-wheat cropping system which works out to be 0.80-0.90 lakh/year/20 kanal but also provide income round the year with good employment generation to the farmer youth (595 man days/year/20 kanal) as well as to meet around 75-80 % of inputs required for different enterprises within the farm. About 62 kg N, 24 kg P2O5, 72 kg K2O are being realized through farm waste composting besides providing all the commodities (cereals, pulses, oilseeds, seasonal high value vegetable crops, fruits, mushrooms, milk, eggs, meat and fish) required for the farm family.

Integrated Farming System seems to be possible solution to the continues increase of demands for food production, stability of income and improvement of nutrition for small and marginal farmers with limited resources and can ensure the highest standard of food production with minimum environmental impact with even high vulnerable climatic condition with available resources accessible to the farmers.

Annexure - I

Performa for Referring Sample to Plant Clinic

Sl. 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	
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/ Another (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. Department	
26.	Sample to be sent to	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 which are Banned, Refused registration and Restricted in use

I. Pesticides / Formulations Banned in India

A.	**Pesticides Banned for manufacture, import and use.**	
	1.	Aldicarb (vide S.O. 682 (E) dated 17th July 2001)
	2.	Aldrin
	3.	Benzene Hexachloride
	4.	Benomyl (vide S.O 3951(E) dated 8th August, 2018)
	5.	Calcium Cyanide
	6.	Carbaryl (vide S.O 3951(E) dated 8th August, 2018)
	7.	Chlorbenzilate (vide S.O. 682 (E) dated 17th July 2001)
	8	Chlordane
	9.	Chlorofenvinphos
	10.	Copper Acetoarsenite
	11.	Diazinon (vide S.O 3951(E) dated 8th August, 2018)
	12.	Dibromochloropropane (DBCP) (vide S.O. 569 (E) dated 25th July 1989)
	13.	Dieldrin (vide S.O. 682 (E) dated 17th July 2001)
	14.	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)
	15.	Endrin
	16.	Ethyl Mercury Chloride
	17.	Ethyl Parathion
	18.	Ethylene Dibromide (EDB) (vide S.O. 682 (E) dated 17th July 2001)
	19.	Fenarimol (vide S.O 3951(E) dated 8th August, 2018)
	20.	Fenthion (vide S.O 3951(E) dated 8th August, 2018)
	21.	Heptachlor
	22.	Lindane (Gamma-HCH)
	23.	Linuron (vide S.O 3951(E) dated 8th August, 2018)
	24.	Maleic Hydrazide (vide S.O. 682 (E) dated 17th July 2001)
	25.	Menazon
	26.	Methoxy Ethyl Mercury Chloride (vide S.O 3951(E) dated 8th August, 2018)
	27.	Methyl Parathion (vide S.O 3951(E) dated 8th August, 2018)
	28.	Metoxuron
	29.	Nitrofen
	30	Paraquat Dimethyl Sulphate
	31.	Pentachloro Nitrobenzene (PCNB) (vide S.O. 569 (E) dated 25th July 1989)
	32.	Pentachlorophenol
	33.	Phenyl Mercury Acetate
	34.	Sodium Cyanide (banned for Insecticidal purpose only vide S.O 3951(E) dated 8th August, 2018)*
	35.	Sodium Methane Arsonate

	36.	Tetradifon
	37.	Thiometon (vide S.O 3951(E) dated 8th August, 2018)
	38.	Toxaphene(Camphechlor) (vide S.O. 569 (E) dated 25th July 1989)
	39.	Tridemorph (vide S.O 3951(E) dated 8th August, 2018)
	40.	Trichloro acetic acid (TCA) (vide S.O. 682 (E) dated 17th July 2001)
B.	**Pesticide formulations banned for import, manufacture and use**	
	1.	Carbofuron 50% SP (vide S.O. 678 (E) dated 17th 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 17th July 2001)
	2.	Nicotin Sulfate
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 24th September 2014)
	8.	Warfarin (vide S.O. 915 (E) dated 15th June 2006)

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

II. Pesticides Refused Registration

Sl.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

Sl.No.	Name of Pesticides	Details of Restrictions
1.	Aluminium Phosphide	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 [1]Aluminium Phosphide 15% 12 g tablet and [2]Aluminum Phosphide 6% tablet. *[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]. [1]Decision of 282nd RC held on 02-11-2007 and, [2]Decision of 326th RC held on 15-02-2012.* 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. (S.O.677 (E) dated 17th July, 2001)
2.	Captafol	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) 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)
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 31st Dec, 2008)
5.	Dichloro Diphenyl Trichloroethane (DDT)	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) 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)
6.	Fenitrothion	The use of Fenitrothion is banned in Agriculture except for locust control in scheduled desert area and public health. (S.O.706 (E) dated 03rdMay, 2007)
7.	Methyl Bromide	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. [G.S.R.371 (E) dated 20th May, 1999 and earlier RC decision]
8.	Monocrotophos	Monocrotophos is banned for use on vegetables. (S.O.1482 (E) dated 10th Oct, 2005)
9.	Trifluralin	(vide S.O 3951(E) dated 8th August, 2018) (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. (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.

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	(i) No new certificate of registration to manufacture shall be issued after publication of this Order. (ii) No person shall import, manufacture or formulate Alachlor with effect from the 1st January, 2019. (iii) The use of Alachlor shall be completely banned with effect from the 31st December, 2020. (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.
2	Dichlorovos	(i) No new certificate of registration to manufacture shall be

		issued after publication of this Order. (ii) No person shall import, manufacture or formulate dichlorvos with effect from the January, 2019. (ii) The use of dichlorvos 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 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.
3	Phorate	(i) No new certificate of registration to manufacture shall be issued after publication of this Order. (ii) No person shall import, manufacture or formulate Phorate with effect from the 1st January, 2019. (iii) The use of Phorate 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 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.
4	Phosphamidon	(i) No new certificate of registration to manufacture shall be issued after publication of this Order. (ii) No person shall import, manufacture or formulate Phosphamidon with effect from the 1st January, 2019. (iii) The use of Phosphamidon 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. (iv) 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.
5	Triazophos	(i) No new certificate of registration to manufacture shall be issued after publication of this Order. (ii) No person shall import, manufacture or formulate

		Triazophos with effect from the 1 st January, 2019. (iii) The use of Triazophos 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 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
6	Trichlorfon	(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 1 st 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.

(Updated on 20.10.2015)

1. Pesticides and Formulations Registered for use in the Country under the Insecticides Act, 1968

S.No.	Name of the Pesticides	Formulation registered	No. of formulation
1.	2,4-Dichlorophenoxy Acetic Acid (2,4-D Sodium Amine and Ester Salt	a) 2, 4-D Sodium Salt used as Tech a.i. 80% w/w min. b) 2,4-D Amine Salt 58% SL 22.5% SL c) 2,4-D Ethyl Ester 38% EC, 4.5% Gr., 20% WP	1 2 3
2.	Acephate	75% SP, 95% SG	2
3.	Acetamiprid	20 SP	1
4.	Alachlor	50% EC, 10% Gr	2
5.	Allethrin	0.5% Coil, 4% Mat, 0.5% Aer., 3.6% L, 0.2% & 0.02% Coil	6
6.	Alphacypermethrin	10% EC, 5% WP, 0.5% Chalk, 10% SC, 0.1% RTU	5
7.	Alphanaphthyl Acetic Acid	4.5% Sol.	1
8.	Aluminium phosphide *(R)	56% Tab, 56% Powder, 77.5% Gr., 6% Tab	4
9.	Ampliomyces quisqualis	2.00% WP	1
10.	Anilofos	30% EC, 18% EC	2
11.	Atrazine	50% WP	1
12.	Aureofungin	46.15% SP	1
13.	Azadirachtin (neem products)	25%, 10%, 0.03% EC, 0.1% EC, 0.15% EC, 5% EC, 0.3% EC, 15% extract conc., 1% EC, 0.1% Gr, 0.15% Gr	11
14.	Azimsulfuron	50% DF (F.I.)	1
15.	Azoxystrobin	23% SC (FI)	1
16.	*Bacillus thuringiensis* var. sphaericus	1.3% FC	1
17.	*Bacillus thuringiensis* var.galleriae	1.3% FC	1
18.	Bacillus thuringiensis var. israelensis	Liquid &WP formulations, 5% AS, 12% AS	2
19.	Bacillus thuringiensis var. kurstaki	5% WP, 2.5% As, 0.5% WP, 3.5% AS, WG	5
20.	Barium Carbonate	1% P	1

21.	Beauveria bassiana	1.15% WP, 1.0% WP, 1.15% SC	3
22.	Bendiocarb	80% WP	1
23.	Benfuracarb	40% EC, 3.0% GR	2
24.	Beta cyfluthrin	2.45% SC	1
25.	Benomyl	50% WP	1
26.	Bensulfuron Methyl	60% DF(FI)	1
27.	Bifenazate	50% WP(FI)22.6% SC(FI)	2
28.	Bifenthrin	10% EC, 2.5% EC, 23.4%, MUP(Imp), 8% SC(FI), 0.05% MC(11 Hrs.), 10% WP, 0.05% MC(8 hrs)	7
29.	Bispyribac sodium	10% SC (FI), 10% w/v SC	2
30.	Bitertanol	25% WP	1
31.	Bromadiolone	0.25% CB, 0.005% RB & 0.005% RB cake	3
32.	Buprofezin	25% SC	1
33.	Butachlor	50% EC, 5% Gr., 50% EW,	3
34.	Captan	50% WP, 75% WP, 50% WDG	3
35.	Carbendazim	25% DS, 50% WP, 46.27% SC	3
36.	Carbofuran	3% CG,	1
37.	Carbosulfan	25% DS, 25% EC, 6% Gr.	3
38.	Carboxin	75% WP	1
39.	Carfentrazone-ethyl	40% EC, 40% DF(FI) 53% MUP(FI)	3
40.	Carpropamid	27.8% SC	1
41.	Cartap Hydrochloride	4% Gr., 50% SP, 75% SG	3
42.	Chlopropham	50% HN	1
43.	Chlorantraniliprole	18.5% SC, 0.4% Gr.	2
44.	Chlorfenapyr	10% SC (FI)	1
45.	Chlorfenuron	10% SC(FI)	1
46.	Chlorfluazuron	5% EC w/w, 5% w/v, 5.4% EC(FI)	3
47.	Chlorimuron ethyl	25% WP,	1
48.	Chlormequat Chloride	50% Sol.	1
49.	Chlorothalonil	75% WP	1
50.	Chlorpyriphos	20% EC, 10% Gr,., 1.5% DP, 50% EC, 2% RTU	5
51.	Chlorpyriphos Methyl	40% EC	1
52.	Chromafenozide	80% WP	1
53.	Cinmethylene	10% EC	1
54.	Clodinafop-propargyl (Piroxofop-propinyl)	15% WP	1
55.	Clomazone	50% EC	1
56.	Clothianidin	50% WG(FI), 50% WG formulation	2
57.	Copper Hydroxide	77% WP, 53.8% DF(FI)	2
58.	Copper Oxychloride	50% WP, 40% Paste, 5% DP, 50 WG	4

59.	Copper Sulphate	Used as Tech 98% equivalent to cooper content 25% w/w min., 2.62% SC	2
60.	Coumachlor	0.5% CB, 0.025% RB	2
61.	Coumatetralyl	0.75% TP, 0.037% Bait.	2
62.	Cuprous Oxide	4% DP	1
63.	Cyantraniliprole	10.26% OD	1
64.	Cyazofamid	34.5% SC (FI)	1
65.	Cyfluthrin	10% WP, 5% EW,	2
66.	Cyhalofop-butyl	10% EC	1
67.	Cymoxonil	80% WP	1
68.	Cypermethrin	10% EC, 25% EC, 1% Chalk, 0.1% Aquous (HH), 0.25 DP, (3% Smoke Generator- to be used only through Pest Control Operators and not allowed to be used	6
69.	Cyphenothrin	5% EC, 0.15% in combination as Aer., 7.2% VP	3
70.	Dazomet	Dazomet Technical (soil Sterilant GR) not permitted on tea	1
71.	Decamethrin (Deltamethrin)	2.5% Flow 2.5% WP 2.8% EC, 0.5% Chalk, 1.25% ULV, 25% Tab., 11% EC, 0.5% Tablet	8
72.	Diafenthiuron	50% WP	1
73.	Diazinon*R	25% Micro Encapsulation	1
74.	Dichloro Diphenyl Trichloroethane (DDT)*R	50% WP, 75% WP	2
75.	Dichloropropene and Dichloropropanes mixture (DD Mixture) *(R)	1:1	1
76.	Diclofop-methyl	28% EC	1
77.	Diclosulam	84% WDG(FI)	1
78.	Diclorvos (DDVP)	76% EC	1
79.	Dicofol	18.5% EC	1
80.	Difenoconazole	25% EC, 3% WS	2
81.	Diflubenzuron	25% WP, 2% Tab FI&FIM, 2% Gr, FI&FIM	3
82.	Dimethoate	30% EC	1
83.	Dimethomorph	50% WP	
84.	Dinotefuran	20% SG (F.I.)	1
85.	Dinocap	48% EC	1
86.	Dithianon	75% WP	1
87.	Diuron	80% WP	1
88.	Dodine	65% WP, 50% flow	2

89.	D-trans allethrin	2% Mat, 0.1% coil, 0.1% coil (12 hr.)	3
90.	Edifenphos	50% EC	1
91.	Emamectin Benzoate	5% SG (FI) & (FIM), 1.9% EC	2
92.	Endosulfan*	2% DP, 4% DP, 35% EC, 4% Gr.	4
93.	Ethephon	39% SL, 10% Paste	2
94.	Ethion	50% EC	1
95.	Ethofenprox (Etofenprox)	10% EC	1
96.	Ethoxysulfuron	10% EC, 15% WG(FI)	2
97.	Ethylene Dichloride and Carbon Tetrachloride mixture (EDCT mixture 3:1)	3:1	1
98.	Etoxazole	10% SC(FI)	1
99.	Fenarimol	12% EC	1
100.	Fenazaquin	10 EC	1
101.	Fenitrothion*R	2% Spray, 20% OL (banned in agriculture use except for locust in scheduled dessert area and public health)	2
102.	Fenobucarb (BPMC)	50% EC	1
103.	Fenoxaprop-p-ethyl	10% EC, 9.3% EC, 6.7% EC	3
104.	Fenpropathrin	10% EC, 30% EC	2
105.	Fenpyroximate	5% EC,	1
106.	Fenthion*R	2% Spray (banned in agriculture use except for locust in scheduled dessert area and public health)	1
107.	Fenvalerate	0.4% DP, 20% EC	2
108.	Fipronil	0.3% Gr., 5% SC, 0.05% Gel (Import) & FIM, 80% WG (FI & FIM), 2.92% EC	5
109.	Flonicamide	50% WG	1
110.	Fluazifop-p-butyl	13.4% EC	1
111.	Flubendiamide	39.35% SC, 20% WG	2
112.	Fluchloralin	45% EC	1
113.	Flufenacet	60% WP	1
114.	Flufenoxuron	10% DC	1
115.	Flumite	20% SC	1
116.	Flusilazole	40% EC	1
117.	Fluvalinate	25% EC	1
118.	Forchlorfenuron (CPPU)	0.1%, 0.12% EC (FI)	2
119.	Fosetyl-Al	80% WP	1
120.	Gibberellic Acid	Tech. P, 0.186% SP, 0.001% L	3
121.	Glufosinate Ammonium	13.5% SL	1
122.	Glyphosate	41% SL, 20.2% SL, 5% SL	3
123.	Glyphosate ammonium salt	71% SG	1

124.	Halosulfuron methyl	75% WG(FI)	1
125.	Hexaconazole	5% EC, 5% SC, 2% SC, 75% WG	4
126.	Hexythiazox	5.45% EC	1
127.	Hydrogen cyanamid	49% age, 50% SC	2
128.	Imazethapyr	10% SL, 70% WG (FI)	2
129.	Imidacloprid	17.8% SL, 70% WS, 48% FS, 30.5% SC, 2.5% Gel, 70% WG, 0.3% Gr	7
130.	Imiprothrin	50% MUP	1
131.	Indoxacarb	14.5% SC, 15.8% EC	2
132.	Iprobenfos (Kitazin)	48% EC, 17% Gr.	2
133.	Iprodione	50% WP	1
134.	Isoprothiolane	40% EC	1
135.	Isoproturon	50% WP, 75% WP, 50% Flow	3
136.	Kasugamycin	3% SL	1
137.	Kresoxim-methyl	44.3%(500 g/l)SC	1
138.	Lambda-cyhalothrin	2.43% CS, 5% EC, 10% WP, 2.5% EC, 0.5% Chalk, 22.8% CS(FI), 4.9% CS	7
139.	Lime Sulphur	22% SC	1
140.	Linuron	50% WP	1
141.	Lufenuron	5.4% EC	1
142.	Magnesium phosphide Plates	56% Min. Plates (FI)	1
143.	Malathion	5% DP, 25% WP, 50% EC,0.25% Spray and 96% ULV, 2% Spray, 5% Spray	7
144.	Mancozeb	75% WP, 35% SC, 75% WG	3
145.	Mandipropamid	23.4% SC	1
146.	Mepiquat Chloride	5% AS, 50% TK	2
147.	Metaflumizone	22% SC (FI)	1
148.	Metalaxyl	35% WS, 40% WS	2
149.	Metalaxyl - M	31.8% ES	1
150.	Metaldehyde	2.5% DP	1
151.	Metarhizium Anisopliae	1.15% WP	1
152.	Methabenzthiazuron	70% WP	1
153.	Methomyl	40% SP	1
154.	Methoxy ethyl mercury chloride *(R)	3% FS, 6% FS (completely banned except for seed treatment of Potato and sugarcane vide S.O. 681(E) dated 17th July 2001)	2
155.	Methyl bromide *(R)	99% L, 98% L	2
156.	Methyl chlorophenoxy acetic acid	40% SL or 40% As	1
157.	Methyl Parathion *(R)	2% DP, 50% EC	2
158.	Metiram	70% WG	1
159.	Metofluthrin	5% EC, 0.005% Mosquito Coil	

160.	Metofluthrin	0.005% Mosquito coil, 5% EC	2
161.	Metolachlor	50% EC	1
162.	Metribuzin	70% WP	1
163.	Metsulfuron -methyl	20% WP, 20% WG(FI)	2
164.	Milbemectin	1% EC	1
165.	Monocrotophos*R	36% SL, 15% w/w SG	2
166.	Myclobutanil	15% SG, 10% WP	2
167.	Novaluron	10% EC (FI), 8.8% SC, 10% EC	3
168.	NPV of *Helicoverpa armigera*	0.43% AS, 2.0% AS	2
169.	NPV of Spodopteralitura	0.5% AS	1
170.	Orthosulfamuron	50% WG	1
171.	Oxadiargyl	80% WP, 6% EC	2
172.	Oxadiazon	25% EC	1
173.	Oxycarboxin	20% EC	1
174.	Oxydemeton-methyl	25% EC	1
175.	Oxyfluorfen	23.5% EC, 0.35% Gr.	2
176.	Paclobutrazol	23% SC(FI), 23% SG	2
177.	Paraquat dichloride	24% SL	1
178.	Penconazole	10% EC	1
179.	Pencycuron	22.9% SC	1
180.	Pendimethalin	30% EC, 5% Gr., 38.7% CS(FI)	3
181.	Penoxsulam	21.7% SC(FI)	1
182.	Permethrin	25% EC, 5% SG., 2% EC, LLIN 2% (FI)	4
183.	Phenthoate	2% DP, 50% EC	2
184.	Phorate	10% CG	1
185.	Phosalone	4% DP, 35% EC	2
186.	Phosphamidon	40% SL,	1
187.	Picoxystrobin	22.52% SC(FI)	1
188.	Pinoxaden	5.1% EC	1
189.	Prallethrin	0.8% mat for 12 hours, 1% Mat, 0.8% L, 1.6% L, 0.5% mosquito coil, 0.04% Mosquito coil, 1.2% mat, 19% w/w VP, 0.6% mat, 2.4% LV	10
190.	Pretilachlor	50% EC, 30.7% w/w EC, 37.0% EW	3
191.	Primiphos-methyl	25% WP, 50% EC, 1% Spray	3
192.	Profenophos	50% EC	1
193.	Prohexadione calcium	10% WG (FI)	1
194.	Propanil	35% EC	1
195.	Propaquizafop	10% EC(FI)	1
196.	Propergite	57% EC	1
197.	Propetamphos	20% EC, 1% Spray	2
198.	Propiconazole	25% EC	1

199.	Propineb	70% WP	1
200.	Propoxur	20% EC, 1% Aer., 2% Aer. 1% HH Spray, 2% Bait	5
201.	Pseudomonas flouroscens	0.5% WP, 1.75% WP, 1% WP	3
202.	Pymetrozine	50% WG(FI)	1
203.	Pyrazosulfuron -ethyl	10% WP, 70% WDG(FI)	2
204.	Pyrethrins (Pyrethrum)	0.2% DP, 2.5% EC, 0.05% Spray, 0.2% PH, 2.0% EC	5
205.	Pyriproxifen	0.5% Gr(FI), 10% EC(FI)	2
206.	Pyrithiobac Sodium	10% EC	1
207.	Pyraclostrobin	20% WG (FI)	1
208.	Quinalphos	1.5% DP, 25% EC, 20% AF	3
209.	Quizalofop ethyl	10% EC, (FI), 5% EC (FI)	1
210.	Quizalofop-p-tefuryl	4% EC (FI)	1
211.	S-Bioallethrin	2.4% mat	1
212.	Sodium Cyanide *(R)	Used as Tech., 96% a.i. min	2
213.	Spinosad	45% SC, 2.5% SC	2
214.	Spiromesifen	22.9% SC	1
215.	Streptomycin + Tetracycline	90: 10 SP	1
216.	Sulfosulfuron	75% WG	1
217.	Sulphur	85% DP, 80% WP, 40% SC, 80% WG/ WDG, 55.16 SC (800 gm/ L) 40% WP, 52% SC	7
218.	Tebuconazole	2.5% DS, 2% DS, 25.9% EC, 25% WG, 5.36% FS, 5.4% FS	6
219.	Tembotrione	34.4% SC	1
220.	Temephos	50% EC, 1% Sand Granules	2
221.	Tetraconazole	3.8% EW (FI)	1
222.	Thiacloprid	21.7% SC	1
223.	Thifluzamide	24% SC	1
224.	Thiobencarb (Benthiocarb)	50% EC, 10% Gr.	2
225.	Thiodicarb	75% WP	1
226.	Thiomethoxam	25% WG, 70% WS, 30% FS	3
227.	Thiometon	25% EC	1
228.	Thiophanate-methyl	70% WP	1
229.	Thiram	80% WP, 40% FS, 75% WS	3
230.	Tolfenpyrad	15%EC	1
231.	Topramizone	336 g/l SC(FI)	1
232.	Transfluthrin	0.88% Liquid Vaporiser, 0.03% Mos. Coil, 20% MV Gel(30 days mat tray), 1% FU, 1.2% LV, 1.6% LV	6
233.	Triadimefon	25% WP	1
234.	Triallate	50% EC	1
235. T	Triasulfuron	20% WG	1

236.	Triazophos	40% EC, 20% EC	2
237.	Trichlorfon	5% DP, 50% EC, 5% Gr.	3
238.	Trichoderma viride	1% WP (CFU 2x10^6 gm/min), 0.5% WP, 5% WP,	2
239.	Tricoderma harzianum	0.5% WS, 2.0% WP	2
240.	Tricoderma viride	1.0% WP	1
241.	Tricontanol	0.05% EC, 0.1% EW, 0.05% GR	3
242.	Tricyclazole	75% WP, 70% WG	2
243.	Tridemorph	80% EC	1
244.	Trifluralin	48% EC	1
245.	Validamycin	3% L	1
246.	Verticillium lecanii	1.15% WP	1
247.	Zinc Phosphide	2% RB, 80% Powder, 1% Bait	2
248.	Zineb	75% WP, 80% WP, 27% Colloidal Suspension	3
249.	Ziram	80% WP, 27% SC	2
		Total	**505**

***R: Restricted**

2. Approved Formulation of Combination Pesticides:

Sl. No.	Combination Product	Company	No. of formulations
A.	**INSECTICIDES**		
1.	Acephate 25% + Fenvalerate 3% EC	M/s Rallis India Ltd., Bangalore	
2.	Acephate 50% + Imidacloprid 1.8% SP	M/s United Phosphorus Ltd.	
3.	Acetamiprid 0.4% + Chlorpyriphos 20% EC	M/s Gharda Chemicals Ltd, Mumbai	
4.	Beta cyfluthrin 8.49% + Imidacloprid 19.81% OD		
5.	Buprofezin 15%+Acephate 35% WP	M/s. Makhteshim Agan Pvt. Ltd.	
6.	Chlorantraniliprole 9.3% + Lambda-cyhalothrin 4.6% ZC	M/s. Syngenta India Ltd.,	
7.	Chloropyriphos 16% + Alphacypermethrin 1% EC	M/s Acco Industries Ltd., Mumbai	
8.	Chlorpyriphos 50% + Cypermethrin 5% EC	M/s De-Nocil, Mumbai	
9.	Cyfluthrin 0.025% + Tranfluthrin 0.04%	M/s Bayer India	
10.	Cypermethrin 10% +Indoxacarb 10% EC	M/s Gharda Chemicals Limited	
11.	Cypermethrin 3% + Quinalphos 20% EC	M/s United Phosphorus Ltd., Mumbai	

12.	Deltamethrin 0.05% + Allethrin.04% L		
13.	Deltamethrin 0.75% +Endosulfan* 29.75% EC		
14.	Deltamethrin 1% + Triazophos 35% EC		
15.	Diazinon 0.5% + Pyrethrum 0.1% ready to use house hold		
16.	Diflubenzuron 20%+ Deltamethrin 2%SC	M/s. Chemtura Chemicals India Pvt. Ltd., Mumbai	
17.	Endosulfan* 35% + Cypermethrin 5% EC	M/s Excel Industries Ltd., Mumbai	
18.	Ethion 40% + Cypermethrin 5% EC	M/s Rallis India Ltd., Bangalore.	
19.	Ethiprole 40% + Imidacloprid 40% (80% WG)	M/s Bayer Crop Science Ltd, Mumbai	
20.	Fipronil 40% + Imidacloprid 40% WG		
21.	Flubendiamide 4% + Buprofezin 20% SC	M/s Rallis India Ltd. Bangalore	
22.	Imiprothrin 0.05% + Cypermethrin 1.0% CL	M/s Godrej Consumer Products Ltd., Mumbai	
23.	Imiprothrin 0.07% + Cypermethrin 0.20% Aerosol	M/s Godrej Consumer Products Ltd., Mumbai	
24.	Imiprothrin 0.1% + Cyphenothrin 0.15%		
25.	Indoxacarb 14.5% + Acetamiprid7.7% SC	M/s Rallis India Ltd., Bangalore	
26.	Methyl bromide 98% + chlorpicrin 2%		
27.	Novaluron 5.25% + Indoxacarb 4.5% SC	M/s Makhteshim Agan India Pvt Ltd, Hyderabad	
28.	Phosalone 24% + Cypermethrin 5% EC	M/s Aventis Cropscience Ltd.	
29.	Phosphamidon 40%+ Imidacloprid 2% SP	M/s United Phosphorus Ltd.	
30.	Profenofos 40% + Cypermethrin 4% EC	M/s Syngenta India Limited, Pune	
31.	Propoxur 0.25% + Cyfluthrin 0.025% Aerosal	M/s Bayer India	
32.	Propoxur 0.5% + Cyfluthrin 0.015% Spray		
33.	Propoxur 0.5% + Cyfluthrin 0.025% Spray,		
34.	Pyriproxyfen 5% + Fenpropathrin 15% EC	M/s Sumitomo Chemical India Pvt. Ltd.	
35.	Thiamethoxam 12.6% + Lambda-cyhalothrin 9.5% ZC	M/s Syngenta India Ltd.	
B.	**FUNGICIDES**		

1.	Ametoctradin 27% + Dimethomorph 20.27% SC		
2.	Captan 70% + Hexaconazole 5% WP		
3.	Carbendazim 12% + Mancozeb 63% WP	M/s United Phosphorus Ltd., Mumbai	
4.	Carbendazim 25% + Mancozeb 50%WS	M/s Indofil Industries Ltd.	
5.	Carbendazim 25% Flusilazole 12.5% SE	M/s Dhanuka Agritech Ltd.	
6.	Carboxin 17.5% + Thiram 17.5% FF	M/s Chemchura Chemical Pvt. Ltd.	
7.	Carboxin 37.5% + Thiram 37.5% DS	M/s Crompton Specialaties Asia Pacific	
8.	Carfentrazone Ethyl 20% + Sulfosulfuron 25% WG	M/s FMC India Pvt. Ltd., Bangalore	
9.	Cymoxanil 8%+Mancozeb 64% WP		
10.	Famoxadone 16.6% + Cymoxanil 22.1% SC	M/s EI Dupont India Pvt. Ltd, Gurgaon	
11.	Fenamidone 10% + Mancozeb 50% WDG(FI)	M/s Bayer Crop Science Ltd	
12.	Fenamidone 4.44% + Fosetyl-Al 66.66% WDG(FI)	M/s Bayer Crop Science Ltd	
13.	Fluocoplide 4.44% + Fosetyl-Al 66.66% WDG(FI)	M/s Bayer Crop Science Ltd	
14.	Hexaconazole 4% + Zineb 68% WP	M/s Indofil Industries Ltd.	
15.	Improvalicarb 5.5%+Propineb 61.25% WP	M/s Bayer Crop Science Ltd	
16.	Iprodion 25% + Carbendazim 25% WP	M/s Aventis Cropscience Ltd., Mumbai	
17.	Metalaxyl -M 3.3% + Chlorothalonil 33.1% SC	M/s Syngenta India Ltd.,	
18.	Metalaxyl -M 8% + Mancozeb 64% WP	M/s Syngenta India Ltd, Pune	
19.	Metalaxyl-M 4% + Mancozeb 64% WP	M/s Syngenta India Ltd.	
20.	Metiram 55% + Pyraclostrobin 5% WG (FI)	M/s BASF India Ltd.	
21.	Propiconazole 10.7% + Tricyclazole 34.2% SE	M/s Syngenta India Ltd, Pune	
22.	Propiconazole 13.9% + Difenoconazole 13.9% EC	M/s Syngenta India Ltd.	
23.	Pyroclostrobin 133g/l+ Epoxiconazole 50 g/l (w/v) SE(FI)	M/s BASF India Ltd.	
24.	Quizalofop ethyl 10% EC + Chlorimuron ethyl 25% WP + Surfactant (0.2) Twin pack	M/s. Dhanuka Agritech Ltd., New Delhi	
25.	Streptomycin + Tetracycline (90+10)	M/s Hindustan Antibiotics	

		Ltd., Mumbai	
26.	Tebuconazole 50% + Trifloxystrobin 25% WG (FI)	M/s Bayer Crop Science Ltd., Mumbai	
27.	Thiophanate Methyl 450 g/L+Pyroclostrobin 50 g/L FS (FI)	M/s B ASF India Ltd.	
28.	Tricyclazole 18% + Mancozeb 62% WP	M/s Indofil Industries Ltd.	
C.	**HERBICIDES**		
1.	Anilofos 24% + 2, 4-D 32% EC	M/s Aventis Cropscience Ltd., Mumbai	
2.	Bensulfuron methyl 0.6% + Pretilachlor 6% Gr	M/s Nagarjuna Agrichem	
3.	Carfentrazone-ethyl 20% + sulfosulfuron 25% WG	M/s FMC India Pvt. Ltd.,	
4.	Clodinafop propargyl 9% + Metribuzin 20% WP	M/s Crystal Plant Protection P. Ltd.	
5.	Clodinafop-propargyl 15% + Metsulfuran methyl 1% WP	M/s United Phosphorus Ltd.	
6.	Clodinafop-propargyl 16.5% + Sodium acifluorfen 8%WP	M/s United Phosphorus Ltd.	
7.	Clomazone 20% + 2,4-diethyl ester 30% EC	M/s FMC India Pvt. Ltd.	
8.	Fenoxaprop-p-ethyl 7.77%+ Metribuzin 13.6% EC	M/s Bayer Crop Science Ltd, Mumbai	
9.	Hexazinone 13.2% + Diuron 46.8% WP(FI)	M/s EI Dupont India Pvt. Ltd., Gurgaon	
10.	Imazamox 35% + Imazethapyr 35% WG(FI)	M/s BASF India Ltd., Mumbai	
11.	Imazethapyr 2%+Pendimethalin 30% EC	M/s BASF India Ltd. Mumbai	
12.	Mesosulfuron-methyl 3% + Idosulfuron-methyl sodium 0.6% WG (FI)	M/s Bayer Crop Science Ltd	
13.	Metfulfuron Methyl 10% + Chlorimuron Ethyl 10% WP	M/s E.I. Dupont India Ltd., Gurgaon.	
14.	Metribuzin 42% + Clodinafop propargyl 12% + WG	M/s United Phosphorus Ltd.	
15.	Oxyfluorfen 2.5% + Isopropyl amine salt of Glyphosate 41% SC	M/s ADAMA India Pvt. Ltd.,	
16.	Pretilachlor 6% + Pyrazosulfuron ethyl 0.15% GR	M/s United Phosphorus Ltd.,	
17.	Sodium Aceflourofen 16.5% + Clodinafop-propargyl 8% EC (FI)	M/s United Phosphorus Ltd.,	
18.	Sulfosulfuron 75% + Metsulfuron 5% WDG	M/s United Phosphorus Ltd.,	
D.	**INSECTICIDE + FUNGICIDE**		

1.	Flubendiamide 3.5% + Hexaconzole 5% WG	M/s Rallis India Ltd.,	

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

Total formulations= 578

Annexure - III

Compatibility of Insecticides vs. Fungicides

	Benomyl	**Bordeaux mixture**	**Brassicol**	**Carbendazim**	**Captafol**	**Cerasan**	**Copper oxychloride**	**Cuman-1**	**Dithane-M45**	**Dithane-278**	**Carboxin**	**Edifenphos**	**Emison**	**Frytolon**	**Karathane**	**Maneb**	**Mancozeb**	**Sulphur**	**Thiophanate methyl**	**Ziram**	**Zineb**	**Thiram**	**Captan**	**Tridemorph-25**	**Oxycarboxin**
1. CHLORINATED HYDROCARBONS																									
Dicofol								C	C	C		C		C								C	C		
Lindane																		C					C		
2. ORGANO PHOSPHATES																									
Chlorpyriphos				C	C		C			C		C											C	C	
Diazinon																						C			
Dichlorvos			C	C			C	C		C							C	C					C		
Dimethoate	I	C	C		C		I	C	C	C		C					C							C		
Etrimphos				C		C		C																	
Fenthion				C	C		C	C		C		C					C			C			C		
Formothion			C				C			C		C					C				C				
Malathion	C		C	C		C		C	C	C	C	C													
Methamidophos				C											C	C						C			
Methyl-demeton				C	C		C			C						C	C				C		C		
Methyl primiphos				C																					
Monocrotophos		C		C	C		C	C	I	C		C	C	C	C		C	C	C			C	C		

Phenthoate		C																							
Phosphamidon		C		C	C		C	C	C	C				C			C				C				
Phosalone			I					C	C	C			C	C	C										
Profenofos										C							C								
Quinalphos									C	C															
3. PYRETHROIDS																									
Cypemethrin			C	C	C		C		C									I					I		
Deltamethrin				C	C		C		C	C							C	C					C		
Fenvalerate	I			C	C		C			C							C								
Flucythrinate				C	C		C			C							C	C					C		
4. CARBAMATES																									
Aldicarb									C	C								C				C			
Carbofuran																						C	C		
Carbosulfan																		C				C			
Primicarb					C											C									

C: Compatible; I: Incompatible

Annexure - IV

Compatibility of Insecticides vs. Plant nutrients (Fertilizers) and Herbicides

	Borax	**Ferrous Sulphate**	**MOP**	**Super phosphate**	**Urea**	**Zinc sulphate**	**Triple super phosphate**	**DAP**	**GA3**	**Atrazin**	**Alachor**	**Dalapon**	**Diuron**	**Linuron**	**Metachlor**	**Metribuzin**	**Norea**	**Ferbutryn**
Acephate				C	C													
Aldicarb					C				C									
Carbofuran					C													
Carbosulfan				C	C													
Chlorfenvinphos				I	I													
Diazinon			C		C					I	I							
Dichlorvos					C													
Dimethoate			C		C			C										
Disulfoton				C	C								I	I		I		
Endosulfan					C													
Fenitrothion					C													
Fensulfothion					C													
Fenthion					C													
HOH						C												
Isofenphos					C													
Lindane			C		C													
Malathion	C	C			C	C						C						
Mephosfolan					C													
Methyldemeton					C													
Monocrotophos					C													
Phenthoate					C			C										
Phenamiphos					C													
Phorate					C										I	I		
Phosphamidon			C	C	C	C						I	I	I	I	I		
Profenofos			C		C		I											
Quinalphos						C												
Tebuphos					C													
Telodrin					C										I	I		
Triazophos					C													

Annexure - V

Compatibility of Insecticides vs. Biopesticides (Insect Pathogens)

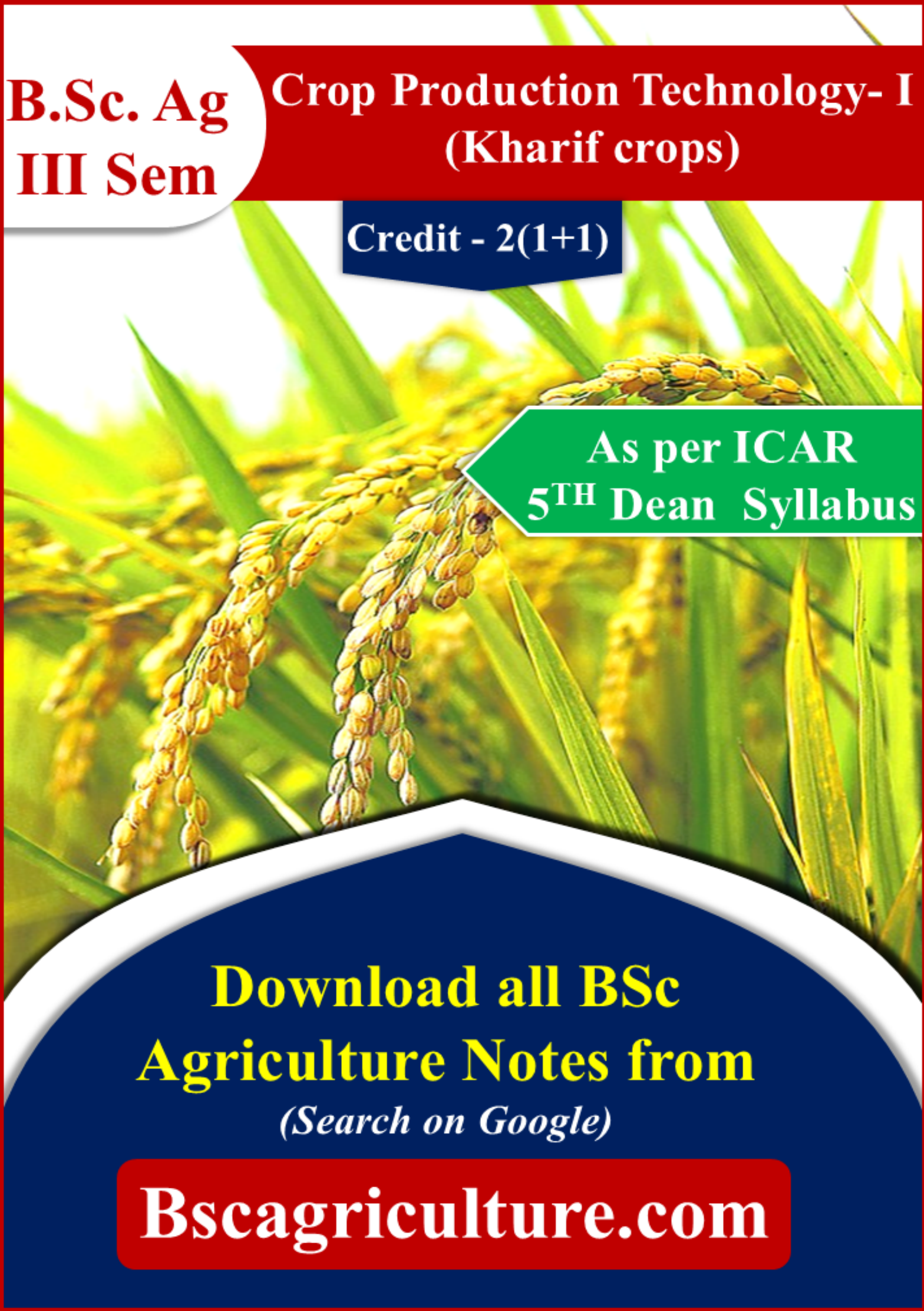
	Bacillus thuningiensis	**Beaveria bassiana**	**Heliothis armigera NPV**	**Adisura atkinsoni NPV**	**Spodoptera litura NPV**	**Trichoplusia in NPV**	**Pasteuria penetrans**
Acephate	C						
Aldicarb	C						C
Carbofuran	C						C
Chlorpyriphos							
Dimethoate	C						
Fenitrothion	C						
Fenthion	C						
Fenpropathrin					C		
Fenvalerate						C	
Methomyl	C						
Methyldemeton	I						
Monocrotophos	C						
Phorate		`					C
Phosalone	C						C
Phosphamidon	C						
Quinalphos	C						

Notes:

B.Sc. Ag
III Sem

Crop Production Technology- I
(Kharif crops)

Credit - 2(1+1)



As per ICAR
5TH Dean Syllabus