

PACKAGE OF PRACTICES FOR KHARIF CROPS

2016



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

Contributors

Division of Plant Breeding and Genetic

Dr.A.K. Razdan, Professor and Head

Dr. S.K. Gupta, Professor

Dr. Bhupash Kumar, Asstt. Professor

Dr. Praveen Singh, Asstt. Professor

Division of Agronomy

Dr. B.C. Sharma, Professor

Dr. A.P. Singh, Assoc. Professor

Dr. Rajeev Bharat, Asstt. Professor

Division of Entamology

Dr. D.P. Abrol, Professor

Dr. V. Kaul, Professor

Dr. Uma Shankar, Asstt. Professor

Division of Plant Pathology

Dr. A.K. Singh, Asstt, Professor

Dr. Sachin Gupta, Asstt. Professor

Dr. R.S. Sodhi, Asstt. Professor

Division of Soil Science

Dr. K.R. Sharma, Professor

Dr. Vikas Sharma, Assoc. Professor

Dr. Vivek M. Arya, Asstt. Professor

Printed by:

Bytes & Bytes

(M) 094127 38797; Email: sandybly@gmail.com

FOREWORD

Sustained growth in agriculture sector is crucial for strengthening agrarian economies in India. Agriculture world over is under continued stress of meeting challenges of increasing food demands, degrading natural resources, climate change threats, opening world economies, changing food preferences and increasing costs of production etc. Agriculture sector needs to march ahead against all such odds.

With the vertical growth in agriculture and allied sectors at a compounded growth rate of 3.3% during the XI Five Year Plan, Indian agriculture provided a major relief to the country being able to meet its minimum needs for agricultural commodities. The serious challenges faced by Indian agriculture have been overcome with the technological back stopping and timely agro advisories provided to the farmers, initiatives taken by the government to improve their socio-economic condition with inclusive agriculture planning.

In order to increase the production and productivity of cereal crops, promotion of improved crop cultivars (High Yielding Varieties), awareness towards improving soil health, strengthening and promotion of farm mechanization, quality control arrangement for seed production and distribution, development of natural resources and demonstrations on crop management and Integrated Pest Management (IPM) are some of the major thrust areas which can be helpful to enhance productivity keeping in view the limited resources available with the state. In this Endeavour, the support from basic and strategic crop science researches in the national agricultural research system in the country has always remained on the priority for the management of the agriculture development with appropriate crop production & protection technologies.

To increase the productivity of main food crops cultivated during the *Kharif* season, successful agricultural operations carry immense importance. Major emphasis is to be laid on introduction of improved crop varieties/ hybrids suited to diverse agro-ecologies and situations endowed with tolerance to various biotic and abiotic stresses, adoption of efficient, economic, eco-friendly and sustainable crop production and protection technologies which should coincide with timely availability of inputs including fertilizers, pesticides, mechanization of farm operations, and improved water management practices. A lot of thrust has also been given to crop diversification from paddy to non-paddy crops, especially in the drought prone rain-fed areas. Increased area coverage with pulses and oilseeds has resulted in significant improvement in their availability to meet internal demands and also ensure a higher return for the farmers.

Jammu & Kashmir state is bestowed with a vast geographical area having different agro-ecological zones ranging from sub-tropical to temperate. The focus has always remained on the management of the scientific development of improved crop cultivars and appropriate crop production & protection technologies with a support from basic and strategic crop science researches in the national agricultural research system in the country.

I am delighted that Directorate of Extension, SKUAST-Jammu has published the Package of Practices for Kharif Crops. The technology package has been revised which includes latest research findings in the areas of interest for the farming community of the region. I hope that the book shall be highly useful for the extension personnel in the dissemination of various technologies. The field functionaries, who are collaborators, consultants, and facilitators in dissemination of the technologies to the farmers, should enrich their knowledge for better implementation in the field. An utmost care has been taken to compile useful information in a simple language for better understanding. However, readers are requested to suggest improvements, if any, so that it can be further improvised.



(Pradeep K. Sharma)

Vice-Chancellor

CONTENTS

S.No.	Particulars	Page No.
1.	GRAIN CROPS	1-35
1.1	Rice	1
1.2	Rice Cultivation in temperate and sub-temperate regions	11
1.3	Basmati Rice	14
1.4	Maize	21
1.5	Bajra	29
1.6	Hybrid Jowar	31
1.7	Lesser Millets	33
	1.7.1 Salan	33
	1.7.2 Kangni	33
	1.7.3 Cheena	34
2.	OIL SEED CROPS	36-39
2.1	Sesamum	36
2.2	Groundnut	37
3.	PULSE CROPS	40-45
3.1	Moong and Mash	40
3.2	Soybean	42
3.3	Cowpea	43
4.	FODDER CROPS	46-59
4.1	Lucerne	46
4.2	Hybrid Napier	47
4.3	Cowpea	48
4.4	Bajra	48
4.5	Jowar	49
4.6	Pioneer Jowar	49
4.7	Guara	50
4.8	Teosinte or Makchari	51
4.9	Deenanath Grass	51
4.10	Kazungula Grass	52
4.11	Subabool	53
4.12	Green Fodder Round the Year	54
4.13	Grass Land Management	55
4.14	Silage making	57
5.	CASH CROPS	60-65
5.1	Sugarcane	60
5.2	Saffron	63
5.3	Zeera	64
6.	PADDY STRAW MUSHROOM	66
7.	APICULTURE	67
8.	ANNEXURES	69

I. 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:

Climatic Requirements: 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 Requirements: Rice grows 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 soils 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.

S.No.	Group	Variety	Remarks
1.	Early	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.
2.	Medium	1. Ratna 2. Tawi (PC-19) 3. SJR-5	Medium duration varieties mature in 120-125 days and are recommended under assured irrigation conditions.
3.	Late	1. Jaya 2. PR-113 3. RR-8585 4. KHR-2 (Hybrid) 5. PHB-71 (Hybrid)	These are late maturing varieties which mature in 135-140 days and are suitable for sub-tropical areas of Jammu, Kathua and Samba districts under assured irrigation conditions.
4.	Rainfed	China-1039 K-39 (SKAU-5)	These are recommended up to an elevation of 1200 m above mean sea level under rainfed conditions.

Promising rice based cropping systems

1. Early rice based cropping systems

a.	Rice IET-1410 (1 st June to 25 th June transplanting)	Toria local (3 rd week of September)	Late sown Wheat variety Raj-3765/PBW-370 (2 nd week of December)
b.	Rice IET-1410 (1 st June to 25 th June transplanting)	Potato: K-Sindhuri (3 rd week of September)	Late sown variety Raj-3765/PBW-370 (2 nd week of December)

c.	Rice IET-1410 (1 st June to 25 th June transplanting)	Potato: K-Sindhuri (3 rd week of September)	Moong (PS-16/PS-7)/ Mash (Pant-U-26)/ Summer fodder (Cowpea + maize + Charry)--- 15 th March-15 th April
d.	Rice IET-1410 (15 th June to 15 th July)	Mustard: RLM-198 (2 nd fortnight of October)	Summer fodder (Cowpea + maize +Charry)--- 15 th March-15 th April
e.	Rice IET-1410 (15 th June to 15 th July)	Berseem for fodder/ fodder and seed production (Mid September to end October)	-
f.	Rice IET-1410 (1 st 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 (15 th June to 15 th July transplanting)	Wheat timely sown variety HD-2967/ DPW-621-50/ RSP-561 (7 th November to 21 st November)	Summer fodder (Maize+cowpea+charry)
b.	Rice variety PC-19/ SJR-5 (15 th June to 15 th July transplanting)	Wheat timely sown variety HD-2967/ DPW-621-50/ RSP-561 (7 th November to 21 st November)	Moong: PS-16 PS-7 (15 th April to 21 st April)
c.	Rice variety PC-19/ SJR-5 (15 th June to 15 th July transplanting)	Berseem for fodder/ fodder and seed production (Mid September to End October)	
d.	Rice variety PC-19/ SJR-5 (1 st week of June)	Peas: Arkal (Mid October to Mid November)	

3. Late rice based cropping system

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

4. Rainfed rice based cropping systems

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

Seed Rate: For transplanting more than two seedlings per hill, use 2 kg of seed per kanal for fine varieties such as IET-1410, Ratna and Tawi (PC-19) and 2.0-2.25 kg per kanal 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 direct sowing, 3.95 kg of seed per kanal is recommended. For hybrids, use seed rate of 750 g/kanal.

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 2.5 g of Carbendazim 50 WP or Captafol 7.5 g or Carbendazim 5.0 g + 2.5 g antibiotics (based on Streptocycline sulphate + tetracycline hydrochloride) in 25 L of water and immerse 25-30 kg of seed for 12 hours and stir thoroughly after every half an hour. Remove the seeds after 12th hour and sow directly.

For dry sowing treat the seed before sowing with Carbendazim @ 2g/kg of seed.

Sowing Time:

S.No.	Group	Variety	Optimum seeding period
1.	Early	IET-1410 & China-1039 or K-39	3 rd to 4 th week of May, however, sowing can be extended upto 3 rd week of June.
2.	Medium	Ratna Tawi (PC-19) & SJR-5	2 nd to 3 rd week of May, however, sowing can be extended upto 3 rd week of June.
3.	Late	Jaya	1 st fortnight of May, however, sowing can be extended upto end of May.
4.	Rainfed	China-1039	On 1 st 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 born disease. Use 10% higher seed rate in intermediate to temperate areas for late group.

Nursery Raising

1. 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 D.A.P. per 10 Sq.m. of nursery bed.

2. 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.

3. 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. 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/kanal after the emergence of first leaf in sprouted seeds or pretilachlor @ 20 g/kanal at 4 DAS.
2. In low-lying and water logged areas where thread worms and root weevil are the problems, incorporate Lindane 1.3 D @ 1.25 kg/kanal in the soil at the time of last ploughing.
3. Protect seedlings from leaf hopper and stem borer by applying Cartap hydrochloride 4G @ 1 kg/kanal or Carbofuran 3 G @ 1 kg/kanal in 5-7.5 cm standing water and keep water standing at least for 72 hours after application or carbaryl 50% WP @ 50 g/kanal when there are 5% dead hearts per sq.m.
4. In case of surface hopper (Tidha) attack, dust the crop with Methyl parathion 2% D @ 1-1.25 kg/kanal in 750 L of add or spray chlorpyrifos 20EC@ 2ml/L of water or 2-3 sprays of spray of neem oil 3% after 21, 42 and 63 days after transplanting.
5. In case of seedling blight, spray the seedlings in the nursery with Zineb @ 75 g/kanal in 37.5 L of water.

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, RR-8585 in 25-30 days after sowing.

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

CONTINGENT PLAN FOR DELAYED TRANSPLANTING OF RICE: 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:

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

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 @ 60-65 kg/ha 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 @ 15 tonnes/ha in the soil after 1st ploughing and before subsequent ploughings.
4. Obtain 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: 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.

S.No.	Variety	Nutrients (kg/ha)			
		N	P ₂ O ₅	K ₂ O	ZnSO ₄
1.	IET-1410 & K-39	50	30	20	20
2.	China-1039	40	30	20	20
3.	Ratna	80	40	25	20
4.	Tawi (PC-19)/SJR-5	120	60	25	20
5.	Jaya	120	60	30	20
6.	KRH-2 (Hybrid)	120	60	30	20
7.	PHB-71 (Hybrid)	120	60	30	20

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

S.No.	Variety	Fertilizer (kg/ha)			
		Urea	DAP	MOP	ZnSO ₄
1.	IET-1410 & K-39	85	65	33	20
2.	China-1039	63	65	33	20
3.	Ratna	140	88	40	20
4.	Tawi (PC-19)/SJR-5	210	132	40	20
5.	Jaya	210	132	50	20
6.	KRH-2 (Hybrid)	210	132	50	20
7.	PHB-71 (Hybrid)	210	132	50	20

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 F.Y.M. or Compost (15 tonnes/ha) 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 added F.Y.M. 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 ZnSO₄, 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 3 g of Zinc Sulphate, 15 kg Urea and 1kg of Zineb/ha in 500 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 60 kg/ha 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 (2nd 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 weeks 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 75 kg Urea/ha. 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 field apply ZnSO₄ immediately. In highly deficient soils broadcast 30 kg/ha of ZnSO₄ (Heptahydrate) or 18 kg/ha of ZnSO₄ (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 fails completely. Give copious irrigation as soon as possible once chlorosis appears. Application of 2 or 3 sprays of 1% FeSO₄ solution at weekly intervals (3 kg of FeSO₄ in 100 L of water/ha).

8. In case of unavailability of FYM - alternatively *Leucaena* biomass @ 2.5 t/ha 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. 5t/ha of rice straw in wheat and 5t/ha 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 20 kg N/ha 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* @ 10 kg/ha has to be applied with a starter dose of N @ 1 kg/kanal at sowing/transplanting.

TRANSPLANTING: 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 China-Mutant K-39	20cm from row to row, 15cm from plant to plant or 15x15 cm
ii) IET-1410, Ratna, Tawi and SJR 5	20 cm from row to row, 10 cm from plant to plant

IRRIGATION AND WATER MANAGEMENT: Maintain 5 cm water, till 5 days after transplanting. Resume irrigation, when hair size cracks develop on soil surface and then follow alternate wetting and drying till maturity or apply 7cm irrigation once in 8 days after 5 days of transplanting during non rainy periods. Stop irrigation three weeks before harvest for uniform and early ripening of the crop. Alternatively the irrigations to the rice should be applied when the soil moisture potential at 150 suction through tensiometer is reached.

INTERCULTURE AND WEED CONTROL: To remove weeds and to stir the soil, 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 and hoeing 15 days after transplanting and second operation after a fortnight. In case, the crop has not been transplanted in lines, two hand weedings may be given as per above time schedule. Weeds can effectively be controlled by applying any of the following herbicides:

1. Apply Butachlor granules 5 G @ 1.5 kg/kanal. 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) @ 62.5+7.5 ml/kanal at 10 DAT.

3. Add Butachlor 50 EC in 7.5 kg/kanal of sand and broadcast in standing water within 2 DAT.
4. Apply Bispyribac sodium @ 1.25-1.50 ml/ha in 500 L of water as post-emergence herbicide at 25-30 DAT. The lower dose is recommended under heavy type of soils 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 @ 1.13 g/kanal at 10 DAT followed by bispyribac @ 1.25-1.5 ml/kanal 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.

PLANT PROTECTION: Rice crop is subjected to the attack of many insects, pests and diseases. The pests and diseases cause considerable losses, if not controlled timely. All the insects and diseases do not occur everywhere and in every field. The type of insect/ disease is found according to the agroclimatic conditions suitable for their survival.

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

S.No.	Name of insect and symptoms of attack	Insect Management
1.	ROOT WEEVIL (<i>Echinocnemus oryzae</i>): 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 15 th June onwards.	Apply granular Viz. cartap hydrochloride 4G or carbofuran 3G @ 1 kg/kanal insecticides 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 appearance, tillering is retarded and growth of plant is checked.	1. Cartap hydrochloride 4 G @ 1.25 kg/kanal 2. Carbofuran 3 G @ 1 kg/kanal 3. Lindane 6 G @ 1.25 kg//kanal 4. Chlorpyriphos 10 G @ 0.5 kg/kanal
3.	STEM BORER (<i>Scirphaga innotata</i> and <i>S. incertulas</i>): 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 porches @ 20/ha. 2. Use pheromone traps @ 1/kanal for mass trapping of the male. 3. Apply the following granular insecticides: Cartap hydrochloride 4 G @ 1.25 kg/kanal. Carbofuran 3G @ 1 kg/kanal. 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 WP @ 30 g/kanal 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 give 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.	<ol style="list-style-type: none"> 1. Remove the weeds spp. viz., <i>Cynodon</i>, <i>Echinochloa</i>, <i>Eleusine</i> 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 200 SL @ 6.25 ml/kanal OR thiamethoxam 25 WA @ 5 g/kanal OR Acephate 75 WP @ 50 g/kanal OR Methyl parathion 50 EC @ 37.5 ml/kanal in 37.5 l of water when 5-10 insects per hill upto mid-tillering and thereafter 20 insects/hill in case of leaf hopper and plant hoppers.
5.	RICE HISPA (<i>Dicladispa armigera</i>): 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.	<ol style="list-style-type: none"> 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 Quinaphos 25EC 50 ml/kanal in 37.5 l 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.	<ol style="list-style-type: none"> 1. Destroy eggs by scrapping the top soil bunds of field before monsoon. 2. Soil application of chlorpyrifos 1.5% D @ 500 g/kanal OR Cartap hydrochloride 4G @ 1 kg/kanal OR chlorpyrifos 20 EC @ 75 g/kanal. 3. With the onset of monsoon, spray the bunds within the cultivable area with Methyl parathion 2% D or Malathion 5% D @ 1.25 kg/kanal. <p>Repeat the spray after 21 days on need basis.</p>
7.	LEAF FOLDER (<i>Cnaphalocrocis medinalis</i>): 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.	<ol style="list-style-type: none"> 1. Use light traps @ 1/kanal. 2. Use rope method to delodge the larvae. 3. Spray betacyfluthrin 0.04% OR chlorpyrifos 0.03% OR Carbaryl 50% W.P @ 7.5 kg/kanal in 37.5 L of water or spray the crop with Monocrotophos 36 SL @ 37.5 ml/kanal OR Chlorpyrifos 20 EC @ 75 ml/kanal.

II. DISEASES AND THEIR MANAGEMENT

S.No.	Name of disease and symptoms	Disease management
1.	BROWN LEAF-SPOT: (<i>Bipolaris oryzae</i>) 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 carbendazim @ 2g/kg seed. Spray the crop with mancozeb @ 0.25%, carbendazim or propiconazole @ 0.1% at the appearance of disease and repeat the spray depending upon the disease severity.
2.	BACTERIAL LEAF BLIGHT: (<i>Xanthomonas oryzae</i> pv. <i>oryzae</i>) 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 streptomycin (2.5g) + copper oxychloride (25g) in 10L of water. Spray the crop with streptomycin (100g) + copper oxychloride (500 g) in 500 L of water at the appearance of disease.
3.	BACTERIAL LEAF STREAK: (<i>Xanthomonas oryzae</i> pv. <i>oryzicola</i>) 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 and fields give a burnt appearance.	Follow the same control measures as in Bacterial Leaf Blight.
4.	SHEATH BLIGHT: (<i>Rhizoctonia solani</i>) 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 carbendazim @ 2g/kg seed. 5. Spray with carbendazim @ 0.1% at the appearance of disease and at boot leaf stage. 6. Follow the crop rotation.
5.	SHEATH ROT: (<i>Sarocladium oryzae</i>) 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: (<i>Ustilaginoidea virens</i>) 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	Spray the crop with copper oxychloride @ 0.3% or carbendazim @ 0.1% at 50% flowering stage.

	formed under favourable conditions. Most of the high yielding varieties are attacked and the incidence varies from 5% to 20%.	
7.	Khaira Disease: (Zinc deficiency) Bronze coloured irregular spots appear on the leaves. Disease mainly appear 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 L of water.
8.	BLAST: (<i>Pyricularia oryzae</i>) 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 thiram @ 2.5 g/kg seed or carbendazim @ 2g/kg of seed. 2. Spray the crop with carbendazim @ 0.1% or tricyclazole @ 0.06%

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.

MATURITY DAYS

S.No.	Variety	Days from Seed to Seed
1.	IET-1410	115-120 days
2.	China-1039	100-110 days
3.	Ratna	120-125 days
4.	Tawi (PC-19)	120-130 days
5.	Jaya/SJR 5	135-140 days

1.2 RICE CULTIVATION IN TEMPERATE AND SEMI-TEMPERATE REGIONS OF JAMMU DIVISION

Rice is also cultivated in cold and warm temperate region 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.

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

Following improved high-yielding varieties are recommended for cultivation:

S.No.	Variety	Area of Adoption
1.	K 39 (SKAU-5)	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	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)
3.	China-1039 SKAU-23 (Chenab) SKAU-27 (Jhelum) SKAU-5 (K-39)	Area falling between 900 to 1550 m height.
4.	Barkat (K-78)	Barkat (K-78) is suitable upto 1800 m above mean sea level and K-332 greater than 1800 m.

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

SEED TREATMENT: Same as mentioned under seed treatment for sub-tropical rice.

SOWING: 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 2.5 to 3.0 kg of seed for raising seedlings for transplanting in a kanal.

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).

FERTILIZER REQUIREMENT: 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/ha)			
	N	P ₂ O ₅	K ₂ O	Zinc Sulphate
China-1039	60	40	20	20
Other varieties	80	40	20	20

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

Variety	Nutrients (kg/ha)			
	Urea	DAP	MOP	Zinc Sulphate
China-1039	95	90	33	20
Other varieties	140	90	33	20

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

FERTILIZER APPLICATION: When 15 tonnes of F.Y.M. or Compost is applied/ha, 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 alongwith 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.

WATER MANAGEMENT: Water level should be maintained at about 3 to 4 cm which may be increased further to a depth of about 6 cm as soon as the seedling establish in the field. Drain the field now and then at tillering stage. Do not drain the field at flowering stage.

Drain the fields 12 to 24 hours before top dressing of fertilizers and re-irrigate the fields after 24 to 36 hours of fertilizer application.

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. Weeds can effectively be controlled by applying herbicides.

1. Apply Butachlor granules 5 G @ 1.5 kg/kanal 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) @ 62.5 ml + 7.5 ml/kanal at 10 DAT.

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

PLANT PROTECTION:

I. Insect and their control

S.No.	Name of insect and symptoms of attack	Control
1.	STEM BORER: Same as mentioned under sub-tropical areas	Same as recommended for sub-tropical areas.
2.	GRASS HOPPERS AND SURFACE GRASS HOPPERS: Same as mentioned under sub-tropical areas	-do-
3.	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 chlorpyrifos 30 EC @ 75 ml/kanal or carbaryl 50% W.P. @ 75 g/kanal in 37.5 L of water and direct the spray nozzle into the whorls.

II. Diseases

Name of disease and symptoms	Control Measure
BLAST: (<i>Pyricularia oryzae</i>) 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 thiram @ 2.5 g/kg seed or carbendazim @ 2g/kg of seed. 2. Spray the crop with carbendazim @ 0.1% or tricyclazole @ 0.06%

Note: If other insects and diseases appear on the crop, adopt the control measure as recommended in case of sub-tropical areas of Jammu Division.

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.

1.3 BASMATI RICE

As regards climate, soil requirement, seed treatment, nursery raising, land preparation, inter culture and weed control, plant protection, harvesting and threshing, the recommendations already made for rice cultivation in sub-tropical parts, hold good for Basmati cultivation too.

Besides above, following recommendations may be followed to boost the Basmati production.

- VARIETIES:**
1. Basmati-370
 2. Basmati 564
 3. Ranbir Basmati
 4. Saanwal Basmati
 5. PRH-10 (Basmati hybrid)
 6. Pusa 1121

CROP ROTATION: Rotate Basmati with wheat crop.

TIME OF SOWING: Sowing of nursery should be completed from 1st fortnight of May to end of May.

TRANSPLANTING:

- (a) In typical water logged area where inundation of water takes place just after first heavy showers in the month of July, the transplanting should be completed from 15th June to July.
- (b) In other areas, the transplanting should be completed from 1st of July to 10th of July.

FERTILIZERS: In absence of soil analysis test, following fertilizer schedule may be followed for an average fertility soil.

Varieties	Nutrient (kg/ha)			Fertilizer (kg/ha)		
	N	P	K	Urea	DAP	MOP
B-370	30	20	10	50	44	16
Pusa 1121	40	25	15	78	55	24

FERTILIZER APPLICATION: Same as recommended for other non basmati varieties under sub tropical conditions.

AGE OF SEEDLINGS AT TRANSPLANTING AND SPACINGS: Age of seedling should be 25 to 30 days at transplanting. Plant 2-3 seedlings per hill keeping row to row distance of 20 cm & plant to plant distance of 10 cm within the rows.

WEED CONTROL: Same as in case of coarse grain rice.

IRRIGATION AND WATER MANAGEMENT: Same as in case of non basmati rice varieties. However, Basmati rice is suitable for typical water logged area 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.

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.

CROP DIVERSIFICATION AND CROPPING SYSTEM RICE BASED

1. Under irrigated conditions of Jammu:

i. Diversification and intensification of need based alternative cropping system

- Rice (var. PC-19)- Marigold (var. Pusa Narangi) - French bean (var. contendor) sequence.
- This sequence has been recommended as most economical. This sequence generates on farm employment for 307 days in a year.

Agronomic management practice

	Kharif	Rabi	Summer
Management practices	Rice (PC-19)	Marigold (Pusa Narangi)	French bean (Contender)
Date of sowing	10 th July to 20 July	10 th Oct. to 20 th Oct.	25 th Feb. to 1 st March
Method of sowing	Transplanting	Transplanting	Line sowing
Seed rate	2 kg/kanal	50 g/kanal	4.25 kg/kanal
Spacing	20 cm × 10 cm	40 cm × 40 cm	60 cm × 10 cm
FYM	-	8 t/ha	8 to 10 t/ha
Fertilizer (N:P ₂ O ₅ :K ₂ O)	120:60:25	120:60:25	50:100:50
Irrigation	9 (no.)	4	4
Weed control	Butachlor 50 EC/ Granules 5% G @ 1.5 kg/kanal	Hand weeding	Hand weeding
Harvesting date	5-10 Oct.	15-20 Feb.	15-20 May
Yield	32-35 q/ha	40-42 q/ha	60-65 q/ha

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

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

Diversified crop sequences, rice-potato-onion have also been identified as profitable and sustainable sequences for realizing higher productivity under irrigated condition of Jammu region.

Agronomic management

	Kharif	Rabi	Summer
Management practices	Rice (IET-1410)	Potato (K. Badshah)	Onion (N-53)
Date of sowing	10 th July to 20 July	10 th Oct. to 20 th Oct.	15 th Jan. to 20 th Jan.
Method of sowing	Transplanting	Ridge sowing	Transplanting
Seed rate	2 kg/kanal	100 kg/kanal	500 g/kanal
Spacing	20 cm × 10 cm	60 cm × 20 cm	10 cm × 7.5 cm
FYM	-	8 to 10 t/ha	8 to 10 t/ha
Fertilizer (N:P ₂ O ₅ :K ₂ O)	60:20:20	120:60:120	100:50:50
Irrigation	9 (no.)	3	3
Weed control	Butachlor 50 EC/Granules 5%G @1.5 kg/kanal	Hand weeding	Hand weeding
Harvesting date	1-5 October	10-15 January	15-20 May
Yield	32-35 q/ha	150-200 q/ha	140 q/ha

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

Agronomic management

	Kharif	Rabi	Summer
Management practices	Rice (IET-1410)	Cabbage (Golden acre)	Onion (N-53)
Date of sowing	10 th July to 20 July	13 th Oct. to 15 th Oct.	10 th Jan. to 15 th Jan.
Method of sowing	Transplanting	Transplanting	Transplanting
Seed rate	2 kg/kanal	30 g/kanal	500 g/kanal
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 ₂ O ₅ :K ₂ O)	60:20:20	120:60:60	100:50:50
Irrigation	9 (no.)	4	4
Weed control	Butachlor 50 EC/Granules 5% G @ 1.5 kg/kanal	Hand weeding	Hand weeding
Harvesting date	1-5 Oct.	28-30 Dec.	10-15 May
Yield	32-35 q/ha	80-85 q/ha	150 q/ha

RICE BASED SITE SPECIFIC NUTRIENT MANAGEMENT

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/100cm³ 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 loan soil for achieving targeted productivity of 16t/ha under rice-wheat system.

Agronomic management

	Kharif	Rabi
Management practices	Hybrid Rice (PHB-71)	Wheat (HD-2967)
Date of sowing	1 st fortnight of July	5 th to 10 th November
Method of sowing	Transplanting (2 seedling/hill)	Line sowing
Seed rate	1.5 kg/kanal	5 kg/kanal
Spacing	20 cm × 15 cm	20 cm
FYM	5 t/ha	--
Fertilizer (kg/ha)*	N P ₂ O ₅ K ₂ O S 150 100 80 50 + 40 ZnSO ₄ , 20 MnSO ₄	N P ₂ O ₅ K ₂ O 150 100 80
Irrigation	10	5
Weed control	Butachlor 50 EC/Granules 5%G @ 1.5 kg/kanal	Metribuzin @ 12.5 g/kanal
Harvesting date	20 th -28 th Oct.	1 st week of May

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

LOCATION SPECIFIC CROP DIVERSIFICATION

(a) Under sub-tropical irrigated areas of Kathua and Jammu (Ghagwal, Hiranagar, Bishnah, Vijaypur, Marh and Bhalwal)

Technology No. 5

Profitable cropping sequence

Crop:	Rice	Potato	Onion
Varieties:	(PC-19)	(K. Badshah)	(N-53)
Fertilizer Dose:	(120:60:30)	(120:60:120)	(100:50:50):: N: P: K/ ha
B:C Ratio	= 2.88		

(b) Under intermediate zone of Udhampur and Kathua (Udhampur, Majalta, Billawar, Basholi, Reasi, Pauni and Rajouri)

Profitable cropping sequence

Crop:	Rice	Potato	Onion
Crop:	Maize+Black gram	Potato	Onion
Varieties:	(Kanchan + Pant U-19)	(K. Badshah)	(N-53)
Fertilizer dose:	(90:40:20)	(120:60:120)	(100:50:50):: N: P: K/ ha
B:C Ratio	= 2.99		

Agronomic management practices:

The agronomic management practices are same as mentioned above.

Methods of crop establishment in Rice-Wheat system

To conserve the resources and improve the crop productivity/soil health under the Rice-Wheat system.

A. Rice-Wheat establishment methods

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

Management practices	Kharif			Rabi		
	Rice (Jaya)			Wheat (HD-2967)		
Date of sowing	6.6.2008 (1 st fortnight of June)			4 November (1 st to 10 th Nov.)		
Method of sowing	Paddy power transplanter/hand Transplanter*			Bed Planting		
Seed rate	1.75 kg/kanal			5 kg/kanal		
Spacing	20 cm × 15 cm			20 cm		
FYM	5 t/ha			--		
Fertilizer (kg/ha)	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O
	120	60	30	100	50	20
Irrigation	09			5		
Weed control	Butachlor 5% a.i. granules (1.5 kg/kanal) at 3 DAT or Pyrozosulfuron @ 25 g/kanal at 10 DAT			Metribuzin 12.5 g/kanal		
Harvesting date	16 to 20-10-08			1 st 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 expanses on nursery uprooting. For this technique an iron frame is used for nursery raising. 100 m² 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 m² is required. A polythene sheet of suitable size is required to avoid the contact of ground 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	6.6.2008 (1 st fortnight of June)	4 November (1 st to 10 th Nov.)
Date of transplanting	2.7.2008	
Method of sowing	8 rows drum seeder (wet seeding)*	Bed Planting
Seed rate	3.5 kg/kanal	5 kg/kanal
Spacing	20 cm × 15 cm	20 cm
FYM	5 t/ha	--
Fertilizer (kg/ha)	N P ₂ O ₅ K ₂ O 120 60 30	N P ₂ O ₅ K ₂ O 100 50 25
Irrigation	10	5
Weed control	Pretilachlor @ 25 g/kanal at 4 DAS or Pyrozosulphuron at 7 DAS @ 25 g/kanal followed by bispyribac 25 ml/ha at 25 DAS	Metribuzin 12.5 g/kanal
Harvesting date	16.10.08 to 20-10-08	1 st 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 @ 500g/ha at 4 DAS or pyrozosulphuron @ 500 g/ha at 7 DAS followed by bispyribac sodium @25 g/ha has shown the good results in keeping the population of the weeds below threshold level.

DIRECT SEEDING OF RICE: Direct seeding is usually practiced in upland rice cultivation. However, it has been observed from several years experimentation at R.S. Pura that direct seeded rice under low land irrigated conditions, yields at par or even higher than transplanted, rice. In fact, direct seeding at optimum moisture yields higher in comparison to transplanting done after first week of July.

It saves labour, time, irrigation water and energy, since there is no need to go for cumbersome operation of puddling and transplanting. Thus large area can be covered within a short period by this method. As such 30-35% of each holding can be shown by this method so that in rest of the area transplanting is complete well in time, resulting in total increase in yield from each holding with less input. The details of direct seeding techniques are as under:

LAND PREPARATION: The land is tilled 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. However, two ploughing should be done before and after irrigation to ensure fine tilth.

SOWING

- **Method of Sowing:** Sow the seed by seed drill manually or bullock or tractor operated. Pora can also be used with narrow opening so that seeds are dropped at the narrowest possible distance width-wise within the single line. This way seeding is made easier both within and between the lines. Practice of growing *Dhaincha* @ 60 kg/ha in inter-row spacing between direct seeded rice field and incorporated at 45-55 DAS shall maintain the productivity and has the potential to replace FYM application.
- **Seed rate:** Use 25-30 kg/ha seed. It is both for coarse and fine varieties.
- **Spacing:** 20-25 cm apart in lines.
- **Depth of Sowing:** 3 to 5 cm
- **Time of Sowing:** Sowing time is spread over longer period i.e. from 5th - 15th June before the start of heavy monsoon showers. It varies in relation to variety.

FERTILIZER APPLICATION: The need of N, P and K varies in relation to variety and is applied accordingly.

S.No.	Variety	Nutrient Requirement (kg/ha)			Fertilizer (kg/ha)		
		N	P	K	Urea	DAP	MOP
1.	Jaya/SJR 5	100	60	30	167	132	50
2.	Ratna	80	40	20	140	88	33
3.	IET-1410	50	30	20	84	66	33

1/3rd N, full P and K are applied as basal while remaining N is top dressed in two equal splits. First top dressing is done at the time of 1st interculture operation i.e. after 1st irrigation and second at the flag leaf stage of crop. Phosphorus and potash should be applied only if the soil test shows deficiency of these nutrients.

IRRIGATION: After sowing, 1st irrigation is to be given at 4 to 6 leaf stage of the crop. Only one irrigation is sufficient for earlier sown crop till the monsoons start. Thereafter, irrigation schedule to be followed is the same as in case of transplanted rice i.e. 5 + 3 cm submergence at active

tillering and reproductive phase and near about saturation at vegetative and maturity stage. However, at earlier stages of crop, moisture is maintained like other dry sown crops.

WEED CONTROL: The success of this method is directly related with the efficiency of weed control. For the control of weeds first interculture operation is to be done when field comes to proper moisture conditions after first irrigation. For this purpose, Blade hoe, V shape hoe or Medium cultivator can be used which require 10 labourers to cover one ha a day. If need arises, depending upon the intensity of weed, Roto weeder can be used in standing water after the start of monsoon rains. In case of late sowing i.e. during first week of June or beginning of July one interculture operation is sufficient with paddy weeder in standing water at 4 to 6 leaf stage of the crop.

Butachlor granules can effectively be used to control weeds in direct sown crop. Apply 30 kg of Butachlor granules/ha just before first irrigation when the crop is at 4-6 leaf stage. Alternatively the weeds can be controlled by chemical application (same as under wet direct seeded through drum seeder).

Application of herbicides has about 80% weed control efficiency. The remaining 20% of the weed can be used as fodder after surface cutting when weeds attain the height of 20 to 30 cm.

PLANT PROTECTION: Same as mentioned under rice cultivation in subtropical areas.

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.

YIELD: It varies in relation to variety:

IET-1410	35 to 45 q/ha
Ratna, PC-19	45 to 50 q/ha
Jaya/SJR 5	50 to 55 q/ha

1.4 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. In spite 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.

CLIMATIC REQUIREMENTS: Maize requires considerable moisture and warmth from the beginning of sowing to the end of flowering. Extremely high temperature and low humidity during the flowering period desiccate the pollen which interfere 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 stages. Maximum reduction in grain yield occurs when crop remains under moisture stress at flowering stage.

SELECTION OF LAND: 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.

PREPARATION OF LAND: 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.

VARIETIES:

HYBRID MAIZE:

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. This hybrid is best under the following crop rotation:
 - i. Maize- Wheat
 - ii. Maize- Toria local----- Wheat HD-1553 (Irrigated areas)
 - iii. Maize- Potato-----Wheat
 - iv. Maize- Sarson-----Moong/Mash
 - v. Maize- Potato-----Fodder/Moong or Mash
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 45 q/ha 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 45 q/ha under mid hills ecology.
4. **HQPM-1:** It is a late maturing yellow grain quality proper single cross hybrid with average yield potential of 50 q/ha. 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 45-50 qts/ha for cultivation in mid hill ecology under irrigated conditions. It takes 130-135 days to maturity.

INTERCROPPING

Maize+moong and maize+mash in the ratio of 1:1 has been found most profitable and promising combination. Two hand weedings done at 20 and 20 DAS or application of pendimethalin @ 167 ml/kanal as pre-emergence or fluchloralin @ 83 ml/kanal as PPI are practiced as better weed control measures.

COMPOSITE MAIZE:

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 50-60 q/ha. It is also recommended for mid elevation of Jammu.
5. **COMPOSITE (TRIKUTA):** It has orange flint grains with a yield potential of 50-60 q/ha. 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 45-50 q/ha. 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 50-60 q/ha.

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.

SEED RATE

1. **FOR PLAIN AREAS:** Use 1 kg of seed/kanal for line sown crop. In case of broadcast sowing, use 1.5 kg of seed/kanal.
2. **HILLY AREAS:** Use 1.75-2.0 kg seed/kanal.

SEED TREATMENT: To avoid diseases ensure seed treatment before sowing. Seed treatment also helps in better germination. Before sowing, treat the seed with Captan or Thiram @ 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 or carbendazim 2 g/kg seed.

TIME OF SOWING:

S.No.	Variety	Area of adoption	Date of sowing
1.	GS-2	Irrigated plains	1 st fortnight of June
	C-8, C-5, Mansar	Unirrigated plains	With the onset of monsoon, but in the case of sowing should be extended beyond 10 th 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 30 th 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 15 th 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 in zone No. IV (8.1) and with cowpeas in Zone No. I, II and III (8.1) and with Mash in Zone No. 1 (1:1).

Following maize + pulse intercropping systems with one row of pulse in between two rows of maize are recommended for zone I and zone II.

1. Maize + Moong [Use recommended seed rate for maize and 1/3rd]
2. Maize + Mash [of the recommended seed rate for pulses.]
3. Maize + Cowpea

MANURES AND FERTILIZERS:

1. Apply 150 quintals well rotten FYM or Compost/ha & 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 150 quintals of FYM/Compost is added, reduce the quantity of below noted nutrients by 25%.

S.No.	Nutrients requirement (kg/ha)				
	Area	N	P	K	Zinc Sulphate (ZnSO ₄ , 7H ₂ O)
1.	Irrigated plain areas	90	60	30	25
2.	Unirrigated plain areas and hilly areas	60	40	20	10

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

S.No.	Fertilizer (kg/ha)				
	Area	Urea	DAP	MOP	Zinc Sulphate (ZnSO ₄ , 7H ₂ O)
1.	Irrigated plain areas	145	132	50	25
2.	Unirrigated plain areas	100	90	33	10

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

METHOD OF FERTILIZER APPLICATION

- a) Drill entire quantity of P and K along with Zinc Sulphate and 2/3rd 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 350 kg/ha gives equally good results as in the case of DAP beside 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 appears in the upper leaves in case of mild deficiency. Mild deficiency disappears by the mid-season but the two stages viz., silking and tasseling are delayed. Broadcast 25 kg of ZnSO₄ Heptahydrate (21%) per hectare in the field where the deficiency symptom appears in the preceding crops. Apply 15 kg/ha ZnSO₄ 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 ZnSO₄- lime mixture prepared by mixing 1.2 kg of ZnSO₄ (21%) and 0.6 kg of unslaked lime or 0.75 kg ZnSO₄ Monohydrate(33%) and 0.375 kg of unslaked lime with 500 L of water to cover one hectare 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.

WEED CONTROL

- (i) **CULTURAL PRACTICES:** Maize crop should be kept free of weeds upto 40 days after sowing, otherwise yield is considerably reduced.

Two hoeing to the crop should be given, one at 15 days and other at 30 days after sowing. 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 reduced the production.

- (ii) **CHEMICAL METHOD:** Atrazine herbicide @ 100 g/kanal in 25 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. Herbicides recommended for maize + pulse intercrops are as follow:
 1. Pendimethalin @ 167 ml/kanal (Pre-emergence)
 2. Fluchloralin @ 83 ml/kanal (Preplant incorporation)

IRRIGATION AND 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.

PLANT PROTECTION:

INSECT PEST AND THEIR CONTROL

S.No.	Name of insect and symptoms of attack	Control measures
1.	MAIZE CUT WORM (<i>Agrotis spp.</i>) 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.	<ol style="list-style-type: none"> 1. Regular raking the field will help to reduce pest attack. 2. Install light traps @ 2/ha for mass collection and destruction. 3. Install pheromone traps @ 40/ha to attract and kill male moths. 4. Prophylactic measures as indicated below, should be under taken to control maize cut worm before sowing. Mix chlorpyrifos 1.5% D or lindane 1.3% D @ 1.25 Kg/kanal in the soil with the last ploughing. Where soil application could not be given spray the crop with chlorpyrifos 30 E.C. @ 150 ml in 50 L of water per kanal. Spraying should be direct on the soil surface.
2.	MAIZE STEM BORER (<i>Chilo partellus</i>) 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.	<ol style="list-style-type: none"> 1. Uproot the stubbles of previous years crop and burn. Spray the crop with methyl demeton 25 E.C. @ 56.25 ml/kanal in 750 L of water cypermethrin 10 EC @ 5 ml/kanal or deltamethrin 2.8 EC @ 10 ml/kanal or dichlorvos 100 EC @ 25 ml/kanal. 2. Apply granular insecticides to control stem borer, viz cartap hydrochloride 4 G @ 1.25 kg/kanal or carbofuran 3 G @ 1 kg/kanal. 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 whories	<ol style="list-style-type: none"> 1. Collection and destruction of moths by using any light device (Lantern, electric bulb etc.) by placing trays containing kerosene + water

	during day. In case of severe infestation feeding may be observed during day also.	(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 dichlorvos 100 EC @ 25 ml/kanal or chlorpyriphos @ 75 ml/kanal or carbaryl 50% WP @ 75 g/kanal in 37.5 L 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 8-10 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.	1. Spray the crop with Carbaryl 50% WP @ 100 g/kanal in 50 L of water at tasselling stage or chlorpyriphos 30 EC @ 0.005%. Since plant height at this stage is maximum, spray should preferably be done with foot or rocking spray pumps. 2. Raising 1 to 2 rows of trap crop like bhindi, 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 @ or imidacloprid @ 0.5 ml/L of water or methyl demeton 25 EC @ 50 ml/kanal in 1000 L 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 Carbaryl 50% WP @ 100 g/kanal in 50 L of water and use foot or rocking spray pumps. Or Chlorpyriphos 30 EC @ 75 ml in 37.5 L of water per kanal.
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 100 ml/kanal or chlorpyriphos 30 EC @ 75 ml/kanal in 37.5 L of water.
8.	WHITE GRUB: Adults feed on leaves. Grubs feed on roots, thus up take of nutrients is reduced.	Use Chlorpyriphos 1.5% D or Lindane 1.3% D @ 1.25 kg/kanal or carbofuron 3G @ 1 kg/kanal. Spray the surrounding area with 0.2% Carbaryl 50% WP @ 75 g in 37.5 L of water per kanal.

DISEASES AND THEIR CONTROL

1.	HEAD SMUT (<i>Sphacelotheca reiliana</i>): 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 carbendazim @ 2 g/kg of seed.
2.	COMMON SMUT (<i>Ustilago maydis</i>): 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.	Treat the seed with captan @ 3 g/kg of seed or carbendazim @ 2g/kg of seed.
3.	STALK ROT (<i>Erwinia chrysanthemi</i> pv. <i>zeal</i>): 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 mancozeb 2.5 kg + 50 g streptomycin in 1000 L of water or apply bleaching powder @ 1.25 kg/kanal.
4.	LEAF BLIGHT (<i>Excerohilum turcicum</i> and <i>Bipolaris maydis</i>): 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 mancozeb @ 0.25% or propiconazole @ 0.1% at the appearance of disease.

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.

The grains from dried cobs should be shelled with traditional methods or with hand corn-sheller and dried in sun for safe storage.

IMPORTANT HINTS FOR MAXIMIZING YIELD

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.

1.5 BAJRA

Bajra has a special importance in unirrigated plain area of Jammu and Kathua districts. The yield of the crop is low because of local seed and local cultivation practices. The 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: It is grown on wide variety of soil but does best on leveled and well drained sandy loam soils as it is highly sensitive to water logging. It is rapid growing warm weather crop, generally suitable for cultivation in areas with 40-65 cm of annual rainfall. The rainfall at the flowering stage is very harmful.

VARIETIES:

1. Composite/Synthetic: W.C.C-75, I-C.M.S-7703
2. Hybrid: MHB-110, MH-179

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

SEED RATE: Use 2 to 2.5 kg of seed/kanal

Always use treated seed. Treat the seed with Bavistin @ 2-3 g/kg seed.

NOTE: Always purchase fresh seeds of Hybrid Bajra every year.

METHOD OF SOWING: 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 (received by thinning the crop). Bajra can be inter cropped with cowpeas, urd/moong by sowing two rows of bajra and one of intercrop.

MANURE AND MANURING: 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.

Nutrient requirement (kg/ha)		
N	P	K
100	60	25

These nutrients can be had from the following fertilizer combination:

Fertilizer (kg/ha)		
Urea	DAP	MOP
212	130	50

Entire quantity of P&K; and half of N may be applied as basal dose along with sowing or before sowing. The remaining half of N may be top dressed after 30-40 days of sowing coinciding with rainfall.

- i) Apply 25 kg ZnSO₄ Heptahydrate (21%) or 18 kg ZnSO₄ Monohydrate (33%) per hectare at the time of sowing in Zn deficient soils.
- ii) Application of potassium is only required in those soils where the soils are deficient in potassium.
- iii) Adjustment of urea dose is necessary, when source of phosphorus is Di Ammonium Phosphate (DAP).
- iv) Nutrients should be applied according to the soil test report of the soil.

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.

WATER MANAGEMENT: See that the field is 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.

PLANT PROTECTION:

I. INSECTS & PESTS:

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 @ 25 kg/ha or Lindane 1.3% D @ 25 kg/ha in 750 L of water.

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 @ 62.5 ml in 37.5 L of water/kanal.

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. DISEASES AND THEIR MANAGEMENT:

Name of the disease and symptoms of attack	Control Measures
GREEN EAR DISEASE OR DOWNY MILDEW: (<i>Sclerospora graminicola</i>) 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	<ol style="list-style-type: none"> 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 the fungicides combination of metalaxyl + mancozeb @ 2.5 g/kg of seed. 4. Follow 3 to 4 years rotation with non host crop. 5. Grow resistant varieties. 6. Spray the crop with metalaxyl + mancozeb @ 0.25% after 30-35 days of seed germination.
ERGOT: (<i>Claviceps microcephala</i>) At blossoming pinkish or light coloured fluid (honey dew) exudes from spikelets on different parts of the ear. Later	<ol style="list-style-type: none"> 1. Early sowing) escapes the disease incidence. Follow two year crop rotation. 2. Dip the seeds before sowing in 10% salt solution

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 ergotamine, which is quite harmful for cattle.	and remove the floating sclerotia. 3. Seed treatment with carbendazim @ 2g/kg of seed. 4. Spray the crop at boot leaf stage with mancozeb @ 0.25%. 5. Ergot infected ears with honeydew should be rogued out and destroyed by burning.
SMUT: (<i>Tolyposporium penicillariae</i>) 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 carbendazim or carboxin @ 2 g/kg of seed. 2. Use certified seed and follow two to three year crop rotation.

HINTS FOR MAXIMUM PRODUCTION:

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

1.6 HYBRID JOWAR

Hybrid Jowar can offer high yields under rain fed 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.

VARIETY: CSH-6, CSH-9

LAND PREPARATION: Select a uniform and leveled piece of 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 150 q/ha 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: Sow with the first break of monsoon rains.

SEED RATE AND SOWING: Use 625 g of seed per kanal. Always sow fresh, healthy certified seed. If the seed is not treated, treat the seed with Captan or Thiram @ 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 so that plants are spaced 10 to 15 cm apart in lines.

MANURING: Apply the chemical fertilizers as per soil test result. However, in absence of soil test results, following schedule of fertilizer is recommended. In case, 150 q of FYM Compost is added per ha, reduce the following fertilizers by 25%.

Nutrient requirement (kg/ha)		
N	P	K
50	30	15

These nutrients can be had from the following fertilizer combination:

Fertilizer (kg/ha)		
Urea	DAP	MOP
83	66	25

METHOD OF APPLICATION: Apply whole quantity of Phosphorus, Potash 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, when the plants are 30 cm high.

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.

NOTE: (1) Do not interculture too near the plants as it damages roots.

(2) See that fields have adequate drainage.

PLANT PROTECTION:

INSECT AND THEIR CONTROL

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 4 G granules at 1.25 kg/kanal or Carbofuran 3 G granules at 1 kg/kanal 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 Carbaryl 50% WP at 75 g/kanal in 37.5 L of water when they appear on the crop.

APHIDS AND JASSIDS: These suck the sap of the plants and make the plants very weak.

Spray the crop with Methyl demeton 25 EC @ 50 ml/kanal or Dimethoate 30 EC @ 50 ml/kanal in 37.5 L of water.

1.7 LESSER MILLETS

1.7.1 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.

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: May is the optimum month for its sowing.

SEED RATE AND METHOD OF SOWING: Use 1 kg seed/kanal. Sow the seeds 2-3 cm deep in rows spaced 30 cm apart.

MANURING: 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/ha)			Fertilizer (kg/ha)		
N	P	K	Urea	DAP	MOP
30	30	-	40	66	-

METHOD OF APPLICATION: 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 forty five days after sowing. The weeding may be done with hand hoes or other interculture implements.

PLANT PROTECTION:

INSECT PEST AND THEIR CONTROL

S.No.	Name of insect and symptoms of attack	Control measures
1.	ANTS: They carry away the seed after sowing.	Apply Lindane 1.3% D or Chlorpyriphos 1.5% D @ 1.25 kg/kanal before sowing.

1.7.2 KANGNI

Kangni is mostly cultivated in rainfed 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.

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

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 1 kg seed per kanal. Sow the seed 2-3 cm deep in rows spaced 30 cm apart.

MANURING: Apply the chemical fertilizers as per soil test. However, in its absence, the following recommendations be followed.

Nutrient (kg/ha)			Fertilizer (kg/ha)		
N	P	K	Urea	DAP	MOP
30	30	-	40	66	-

METHOD OF APPLICATION: Apply 2/3rd nitrogen and full dose P as basal 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.

PLANT PROTECTION:

INSECT, PEST & THEIR CONTROL

S.No.	Name of insect and symptoms of attack	Control measures
1.	ANTS: They carry away the seed after sowing.	Apply lindane 1.3% D or chlorpyriphos 1.5% D @ 1.25 kg/kanal before sowing.

1.7.3 CHEENA

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.

SOIL: It is generally cultivated in marginal soils.

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

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 stand.

SOWING TIME: June and July are the ideal months for its sowing.

SEED RATE AND METHOD OF SOWING: Sow seed @ 1 kg/kanal. Sowing should be done 2-3 cm deep in rows spaced 30 cm apart.

MANURING: Apply the chemical fertilizers as per soil test. However, in its absence, apply the following schedule of fertilizers:

Nutrient (kg/ha)			Fertilizer (kg/ha)		
N	P	K	Urea	DAP	MOP
30	30	-	40	66	-

METHOD OF APPLICATION: Apply 2/3rd of nitrogen and full 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.

PLANT PROTECTION:

INSECT, PEST AND THEIR CONTROL

S.No.	Name of insect and symptoms of attack	Control measures
1.	ANTS: They carry away the seed after sowing.	Apply chlorpyriphose 1.5% D or lindane 1.3% D @ 1.25 kg/kanal before sowing.
2.	TOP SHOOT BORER: It attacks cheena resulting in unfilled grains and sterile panicle	Spray chlorpyriphos 30 EC @ 75 ml/kanal or dichlorvos @ 25 ml/kanal or cypermethrin 10 EC @ 5 ml/kanal.

DISEASE AND THEIR CONTROL:

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 dryland belt of Jammu province and generally is grown under rainfed conditions.

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

VARIETY: Punjab Til-I

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 100 to 125 g of seed per kanal. 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. Sow the crop in lines 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.

MANURING: Apply 5q of well rotten FYM/Compost/kanal and incorporate it well in the soil with the last ploughing. In light soil of low fertility, the following plant nutrients may also be applied:

(kg/ha)		
N	P	K
20	10	-

The above nutrients can be made available from these fertilizers.

(kg/ha)	
Urea	DAP
35	22

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 plants during interculture operation to maintain plant to plant distance of 15 cm within rows.

PLANT PROTECTION: 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 chlorpyrifos 1.5% D or lindane 1.3% D @ 1.25 kg/kanal or spray the crop with carbaryl 50% WP 75 g/kanal 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 @ 1 ml/L of water or demeton methyl 25 EC @ 1 ml/L of water or imidacloprid 200 SL @ 0.5 ml/L of water.

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 is 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 (0.25g) + streptomycin sulphate (250 ppm).

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.

HINTS FOR MAXIMISING 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.

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 can also be put under groundnut cultivation.

VARIETIES: PUNJAB NO-1, M-13 and JL-24

SEED RATE AND SEED TREATMENT: Healthy and well filled pods should be hand shelled about a fortnight prior to sowing. Treat the seed with Thiram or Carbendazim @ 2g/kg seed. About 5 kg of pods are sufficient for one kanal.

TIME OF SOWING: The rainfed crop can be sown in March/April and from the last week of June to 1st 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 be adopted.

MANURES AND FERTILIZERS: Apply the fertilizers as per recommendations of the soil test results. However, in general recommendations are as under:

(kg/ha)		
N	P	K
15	40	25

The above nutrients can be made available from these fertilizers.

(kg/ha)			
Urea	DAP	MOP	Gypsum
35	81	45	125

Drill all fertilizers at sowing. Gypsum should be broadcasted. Prefer phosphorus dose from Single Super Phosphate (SSP) @ 6.25 kg/kanal.

Zn deficiency: Reduction in size of leaves are 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 kernel are shriveled. Apply 3.1 kg ZnSO₄ Heptahydrate (21%) or 2.0 kg ZnSO₄ Monohydrate (33%) per hectare. 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. Do not bury the plants in earthing up operation.

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

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

PLANT PROTECTION:

I. INSECT PESTS AND THEIR CONTROL: 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 Lindane 1.3% D @ 1.25 kg/kanal 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 @ 50 ml/kanal or Dimethoate 30 EC @ 50 ml/kanal in 750 L of water. White grub-same as in maize crop.

II. 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: (<i>Cercospora arachidicola</i>) 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. Lesions also appear on petioles, stems, stipules. In severe cases several lesions coalesce and result in premature senescence.	Spray the crop with carbendazium @0.05% or mancozeb @0.2% at 15 days interval.
Stem rot: (<i>Sclerotium rolfsii</i>) 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 carbendazium or thiram @ 2g/kg of seed or with biological control agents such as <i>Trichoderma veride</i> @ 4g/kg of seed.

Seed treatment with captan or thiram @ 2.5 g/kg of seed. Spray the crop with mancozeb @ 0.2% or copper oxychloride @ 0.3% or carbendazim @ 0.1% or imidacloprid @ 0.5 ml/L of water.

HARVESTING: The crop should be harvested when most of the leaves turn yellow and start shedding.

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.

PREPARATION OF LAND: 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.

VARIETIES:

i)	MASH	PANT U-19, UTTARA	Suitable both for <i>kharif</i> season and for summer sowing.
ii)	MOONG	PDM-54, ML-131, ML-818	However varieties of moong, viz., PS-16, PS-7 can be sown during summer season only.
		SML-668	For summer sowing as well as main season but in main season YMV is to be controlled.

SEED RATE: Use 750 g to 1.0 kg of seed per kanal. Treat the seed with Thiram or Captan @ 3g per kg of seed, before sowing.

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.

MANURES AND FERTILIZER: 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/ha)		Fertilizer (kg/ha)
N	P	DAP
16	40	90

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

- i) **CULTURAL WEED CONTROL PRACTICES:** 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.
- ii) **CHEMICAL METHOD:** Use fluchloralin @ 83 ml/kanal in 800-1000 L of water as pre-plant incorporation to control weeds in the field or pendimethalin @ 167 ml/kanal as pre-emergence application.

IRRIGATION: Generally during *kharif*, mash crop does not require any irrigation, but in case of failures of rains, the crop should be irrigated. 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, 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.

INSECT 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 instar larvae present on the underside of leaves.
 - b.) Hand pick and destroy grown up caterpillars.
 - c.) Spray chlorpyrifos 30EC @75 ml/kanal or carbaryl 50% WP @75 g/kanal in 37.5 L 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 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 or dimethoate 30 EC or triazophos 40EC or imidacloprid 200SL or fipronil 5 SC (0.3%).

DISEASE MANAGEMENT

Symptom	Management
Cercospora leaf spot (<i>Cercospora canescens</i>): 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 mancozeb (0.25%) or carbendazim (0.05%) 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 up on disease severity.
Ascochyta leaf spot (<i>Ascochyta phaseolorum</i>): Dark coloured, circular lesions with concentric rings are formed on leaves. In severe cases, short holes surrounded by remnants of concentric rings are formed.	Same as for management of Cercospora leaf spot.
Anthracnose (<i>Collectotrichumcapsici</i>): Crescent-shaped, dark brown spots are formed on leaves. Later on spots develop concentric rings. In severe cases, the lesions may coalesce resulting in burnt appearance. Dark coloured spots are also seen on pods.	Recommended as above for management of Cercospora leaf spot.
Powdery mildew: (<i>Erysiphe polygoni</i>) 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 with dinocap @ 0.05%.

<p>Yellow mosaic: (Moong bean yellow mosaic virus (MYMV)) 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.</p>	<p>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 imidacloprid @ 0.5 ml/L of water or thiamethoxan @ 0.03%.</p>
--	--

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.

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.

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.

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.

VARIETIES: 1) BRAGG, 2) CLARK-6, 3) PB-1 for hills

SEED RATE: Use 3.13 kg of seed per kanal.

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 affects 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.

Sow PB-I Variety during 1st fortnight of May in hilly areas.

FERTILIZER REQUIREMENT: Apply the following plant nutrients to get a good yield. These plant nutrients can be made available from the following fertilizers:

(kg/ha)					
N	P	K	Urea	DAP	MOP
20	40	20	10	88	33

Drill whole DAP & MOP at the time of sowing. Top dress 10 kg urea. Green manure the field with sunhemp using 2.5 kg seed/kanal 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. Practice green manuring and apply full dose of nitrogen (1.5 kg N/kanal) 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: It is a rainy season crop and generally no irrigation is given. However, if rains fail during the growing period, one irrigation at the time of pod filling is very useful.

PLANT PROTECTION: Hairy Caterpillar, Flea beetle, Jassids and White fly damage the crop. Adopt the following control measures to control these insect pests.

1.	HAIRY CATERPILLARS	i) Mechanical control same as in Til crop. ii) Dust the crop with lindane 1.3% D @ 1.25 kg/kanal or spray the crop with chlorpyrifos 30 EC @ 75 ml/kanal in 37.5 L of water.
2.	JASSIDS AND WHITE FLY	Spray the crop with dimethoate 30 EC @ 50 ml/kanal in 37.5 L of water.

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.

3.3 COWPEA

Cowpea are 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 package of practices are recommended:

VARIETIES: C-152, PS-42, CULTURE-1

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 number of irrigations required are less.

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.

MIXED CROPPING: For Zone No. III cowpeas can be sown mixed with maize and in Zone No. II with bajra. Sow one row of cowpeas and two rows of maize/bajra.

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 1-1.25 kg/kanal seed for pure crop and 0.5 kg/kanal for mixed crop with maize.

INOCULATION: Inoculate the seeds with Rhizobium culture before sowing.

FERTILIZER APPLICATION: As a pure crop, it requires 18 kg N and 46 kg P/ha i.e. 100 kg DAP, 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: 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 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.

YIELD: The yield varies from variety to variety. The higher yield is obtained from C-152 variety, although its grains are of brown colour. It yields 15 to 20 q/ha during summer and 8-10 q/ha during rainy season. Other varieties yield less than this variety but grain quality is better, being milky white in colour.

MIXED CROPPING OF RAJMASH WITH MAIZE

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

All the practices required for maize crop are needed for this crop besides, following points are required to be observed for increasing the rajmash production from a mixed crop.

SEED RATE: Use 1 kg of maize seed and 75 g of rajmash seed per kanal. Mixed cropping of maize & rajmash can be undertaken by using seed rate of 8:1.

SOWING: The sowing should be done in proper moisture conditions at a depth of 5 cm. Rajmash seed should be sown within rows of maize plant.

SOWING TIME: Sowing time of rajmash coincides with the sowing time of maize.

FERTILIZERS: No additional fertilizers are required for rajmash crop. Fertilizers recommended for maize are sufficient to meet its requirement.

HARVESTING: The pods from the earlier flushes of flowers mature earlier, which exhibit shattering tendency and should be hand picked. The pods from later flushes be harvested subsequently.

PLANT PROTECTION

INSECT PESTS

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.

DISEASE MANAGEMENT

Rajmash	
Anthracnose (<i>Colletotrichum</i> 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.	<ol style="list-style-type: none"> 1. Obtain seed from disease free locations. 2. Treat seed with carbendazim @ 2.5 g/kg seed.
Angular leaf spot (<i>Phaeoisariopsis griseopla</i>): Numerous small, angular, brown spots appear on foliage and on pods, dark brown to black, circular spots are formed. Sometimes pods are deformed.	<ol style="list-style-type: none"> 1. Use healthy seed. 2. Treat seed with carbendazim @ 2.5 g/kg. 3. Spray the crop with carbendazim (0.1%) 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 (<i>Ramularia phaseoli</i>): 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 (<i>Xanthomonas axonopodis</i> pv. <i>Phaseoli</i> var. <i>fuscans</i>): 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.	<ol style="list-style-type: none"> 1. Obtain seed from disease free area. 2. Follow crop rotation of 3 years.

4.4 FODDER CROPS

4.1 LUCERNE (*Medicago sativa*)

This is an important perennial leguminous forage crop and is generally known as king 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 up to an altitude of 3300 m or more. It is resistant to frost and can also withstand temperature up to 49°C and drought as well. Average height of the plant is about 80 cm.

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. 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 leveled 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.

VARIETIES: SIRSA-8 and SIRSA-9 are good fodder varieties for tropical and sub-tropical regions.

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. Lines should be 30-40 cm apart. The seeds should not be sown more than 1 cm deep as shallow sowing ensures proper germination.

SEED RATE: For line sown crop 750 g to 1 kg of seed/kanal is enough to obtain good yield.

INOCULATION: Inoculate the seed with Rhizobium culture before sowing.

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.

MANURES AND FERTILIZERS: 5 to 6 tonnes/ha of well rotten F.Y.M. is applied and mixed with soil well before sowing. 60 kg P and 5 kg N/ha is given as basal dose. After 1st and 3rd cutting, application of 80 kg of DAP/ha 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: 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 subsequent 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.

CUTTING AND YIELD: 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 600-800 q/ha 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.

AREA OF ADOPTION: It requires hot and moist climate and can be grown in Jammu, Kathua and some parts of Udampur district. It can also be grown successfully on lower hills.

VARIETIES: PUSA GIANT and hybrid napier -21

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 900-1000 plant per kanal 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 crop, whereas intercrop with maize/cowpea fodder in kharif and berseem in rabi season, the planting distance shall be 1.2 m × 60 cm.

MANURING AND FERTILIZER APPLICATION: Apply 20 cart loads of well rotten compost or F.Y.M/ha at time of land preparation.

Under Irrigated conditions, apply 80 kg N and 40 kg P per hectare whereas under unirrigated conditions, apply 40 kg N and 20 kg P/ha.

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: 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.

YIELD: It yields about 1000-1150 quintals of green fodder per year.

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 rainfed conditions. It is also hay crop. It grows very well under orchards. ###

VARIETIES: EC-4216 and HF-642-1 are the most suitable varieties of cowpeas for fodder. TYPE-2 is also suitable.

PREPARATION OF LAND: Sowing starts from 1st 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: 2.5-3.0 kg/kanal depending upon the method of sowing.

INOCULATION: Inoculate the seed with Rhizobium culture.

MANURES AND FERTILIZERS: To ensure a good stand and yields, 60 kg P & 20 kg N/ha is given as basal dose, 20 kg N is top dressed after 40 days of sowing.

INTERCULTURE AND IRRIGATION: 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. 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 150 to 200 q ha.

MIXED CROPPING: Cowpeas can be grown mixed with guara, teosite, bajra, chari and nappier.

4.4 BAJRA FODDER

Bajra is an important kharif fodder crop and can be grown both under irrigated and rainfed conditions. This crop is suitable for kandi areas of this division. It can withstand 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: S-530, F-2 generation of HB.1 or any open pollinated variety.

LAND PREPARATION AND SOWING TIME: Light soils are preferred for its cultivation, 2-3 ploughings are sufficient. Removal of stubbles from field is essential. It is sown from ending April to mid May and can be extended upto mid July under rainfed conditions.

SEED RATE AND METHOD OF SOWING: 0.5 kg of seed/kanal is recommended. For fodder production, broadcasting is preferred. The crop is also sown mixed with legumes like cowpeas or guara. The seed rate in that case is reduced to half.

MANURE AND FERTILIZERS: Apply 7-10 tonnes/ha of well rotten FYM at least 3-4 weeks before sowing, 30 kg N & 40 kg P/ha is also applied as basal dose. 30kg N/ha is given as top dressing followed by irrigation or before the rain is expected.

IRRIGATION: 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 25-33 tonnes/ha 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 rainfed conditions. It gives best stand where there is low rainfall and high humidity. Jowar is also relished very much by cattle as silage.

VARIETIES: Important varieties are UJJAIN, SWARNA-413, TYPE-4 and M.P. CHARRI.

TIME 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.

SEED RATE AND METHOD OF SOWING: Seed rate varies from 2.5-3.0 kg/karnal depending upon the method of sowing. The crop should be sown 33 cm apart for seed production and for fodder it should be sown by broadcasting. Use 30 kg of jowar seed and 30 kg of cowpeas seed per hectare when sown mixed.

MANURE AND FERTILIZERS: Well rotten F.Y.M. @ 7-10 tonnes/ha is applied at least a month before sowing & thoroughly mixed with soil. In addition, 40 kg N and 40 kg P/ha are given as basal dose. Top dressing of 20 kg N/ha is given after 40 days of sowing, followed by irrigation or before rainfall is expected.

IRRIGATION: 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.

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 wood/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 300-350 q per ha. (To avoid wastage, fodder should be chaffed before feeding)

MIXED CROPPING: Jowar can be sown mixed with other crops like M.P. Charri or cowpeas or moong or mash.

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.

TIME OF SOWING: It can be sown from March to July in the irrigated areas but in unirrigated areas, it should be sown in the month of July only.

SEED RATE: Use 1.25 to 1.5 kg of seed/karnal.

SPACING: Sowing is normally done by broadcasting.

METHOD: In case, seed drill is used, keep a distance of 30 cm from line to line and 10 cm from seed to seed.

FERTILIZER DOSE: Apply 125 kg DAP and 60 kg urea at the time of sowing and 75 kg urea after each cut/ha.

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.

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 CLIMATIC REQUIREMENTS: 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: FS-227 and Ageta Guara-III

SOWING TIME: The sowings of the fodder crop start 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.

METHOD OF SOWING AND SEED RATE: The fodder crop be sown by broadcasting the seed or in rows 30 cm apart and the seed crop in rows 45 cm apart. For pure fodder 2.25-2.5 kg of seed/karnal and for mixed sowing fodder with chari, maize, bajra etc. 1.25 to 1.5 kg/karnal of seed is recommended. For seed crop 20-25 kg of seed is sufficient for one hectare.

MANURING: It is legume crop, so only a starter dose of 10-15 kg of N/ha be given. About 20-25 kg of P/ha should be drilled before sowing for getting good yields from this crop.

IRRIGATION: 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. Generally 300-450 q of green fodder/ha is obtained. Good crop raised for seed production can yield 10-12.5 q of grain per hectare.

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.

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

SOIL: Rich well drained soil.

VARIETY: SIRSA Improved, provides fodder during scarcity period of October-November.

MANURING: FYM 40 tonnes/ha, N 50 kg/ha, P 40-50 kg/ha and K 30-40 kg/ha.

BASAL DOSE: 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.

TOP DRESSING: The remaining N is to be top dressed in two to three equal splits after each cut.

SOWING: (Time of sowing): March to August.

SEED RATE: 2-2.5 kg/karnal for fodder & 1-1.25 kg/karnal for seed production.

ROW TO ROW DISTANCE: 30 cm for fodder production/45 cm for seed production.

IRRIGATION: 4-5 irrigation are required.

HARVESTING: Ist cutting 60-70 days after sowing & sub-sequent cut 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: 800 to 1000 q/ha Grain: 100 to 120 kg/ha

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 rainfed 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.

PREPARATION OF LAND: 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 375 g/karnal required depending upon the method and time of sowing.

TIME OF METHOD OF SOWING: Under irrigated conditions, the sowing of grass can be done from 2nd week of April to ending May. But under rainfed 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 FERTILIZER: About 200 q/ha of well rotten FYM is applied one month prior to sowing. 60 kg, 40 kg and 15 kg of N,P & K/ha respectively 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: 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 300 q/ha 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 can be grown successfully upto an elevation of 1500 m. It can be grown under both rainfed and irrigated conditions. As rainfed 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.

PREPARATION OF LAND: 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 1500 root slips are required to plant an area of one karnal.

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 60 x 60 cms.

MANURES AND FERTILIZER: 125 to 200 q of well decomposed FYM should be applied to the field about one week before planting of the grass.

IRRIGATION: The crop should be irrigated frequently during hot summer days.

YIELD: Under irrigated conditions, the green fodder yield comes about 900 q/ha 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.

MIXED CROPPING: It can be grown mixed with guara, lucerne, cowpea or velvet beans.

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 be cut by sharp pruning scissors or with dranti.

YIELD: 120 to 150 q/ha of fodder during 1st year. During 2nd year 50 to 75 q/ha of fodder from subabul alone can be obtained. In closer spacing 250 to 280 quintals of fodder/ha 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 rabi, 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 quantity 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 after 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 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/Sterea 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 irrigated & rain fed areas.	Oct.- Nov.
4.	Deenanath grass	Early July	Suited even for rainfed areas.	Oct.- Nov.
5.	Hybrid Napier/Sterea 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 Berseem + 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 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 ecocise, grow stabilize and compete with local flora, so that a rangeland is converted into a 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, Ipomea, 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 production 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 200-250 g/kanal of each grass and legume species. For grass alone 300-350 g/kanal of seed is sufficient. Seed can be sown after tillage of the area or by pit method of the spacing of 50 cm 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 sateria, 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.	300-5000 m	Dinanath grass, Cenchrus, Dicanthium, Anjan grass		Soo-babool, serier Dhamman Khair, Albizia Bamboo etc.
2.	500-1000 m	Cenchrus, Dicanthium, Deenanath, Napier Seteria	Dojiches lablab, Hamata Red clover	Lab Dhaman, series bamboo, quercus, salix, Mulberry Albiza
3.	1000-2000 m	Chrysopogon cenchrus, Cymopogon, Themeda, Lolium etc.	Stylosanthes Kudzucine	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 Quircus, Banknor etc.

C) FERTILIZATION OF THE GRASS LAND: 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 40 to 60 kg N and 20 to 40 kg P₂O₅ per hectare. 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 types 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 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 weeds 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. Ensure that the silo trench is completely air tight. Alternatively, before filling, polythene sheet of the grade 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 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 forage is too rich in proteinaceous substances, the rich butyric acid is one of the acid type fermentation will predominate. 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 such cases, preservative liked molasses at the rate of one 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 an 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.

CLIMATIC REQUIREMENT: 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 REQUIREMENT: 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

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
(Planting time (1st week of Oct- February last week)

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

LAND 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 during 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 sets usually 30-45 cm in length. About 30,000-40,000 sets are sufficient to plant one karnal (3.75-4.0 quintal by weight).

SEED TREATMENT: Sugarcane sets 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 sets 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.

DISEASE AND MANAGEMENT

Name of Disease and symptoms of attack	Control measures
Red rot (<i>Collectotrichum falcatum</i>): 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.	<ol style="list-style-type: none">1. Select the healthy sugarcane setts.2. Grow resistant varieties recommended for the particular area.3. Dip the setts in carbendazim (0.2%) for 20 minutes before planting.4. Do not ratoon for diseases crop.5. Long crop rotation should be followed.
Grassy shoot or Albino disease (<i>Phytoplasmas</i>): 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.	<ol style="list-style-type: none">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 dimecron (0.02%) for 2-3 times at 15 days interval to avoid the disease spread.
Ratoon stunting (<i>Ricketessia like organism</i>): 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.	<ol style="list-style-type: none">1. Grow resistant varieties.2. Plan setts only for healthy canes.3. Do not ratoon the diseased plants.

PEST ATTACK:

- a) **Pests:** Application of chlorpyrifos 20 EC (5 L in 1500 L of water) over the sets 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 @ 25 kg/ha.

TIME OF PLANTING: March is the best time for planting.

METHOD OF PLANTING: 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 sets are planted in them end to end. After that furrows are covered with 5-7 cm of soil and field is leveled by a planker or alternatively the ring pit planting method has been found more remunerative. The pit of 90cm diameter having depth of 45 cm is being dug and the sugarcane sets dipped in 0.1% solution of carbandazium for 30 minutes are planted in these rings.

MANURES AND FERTILIZERS: Sugarcane is a heavy feeder of nutrients, 50 tonnes of FYM or compost/ha 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/ha)			Fertilizer (kg/ha)		
N	P	K	Urea	DAP	MOP
150	75	75	264	165	125

Apply $\frac{1}{2}$ N and total P and K at planting. Remaining N be applied in two split dose i.e. $\frac{1}{4}$ th at the beginning of tillering phase in June and the rest $\frac{1}{4}$ th at the end of grand growth phase in July and August.

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 specially 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 sets properly. The second hoeing is undertaken 3 weeks after sowing and subsequent hoeing done after every irrigation before tillering starts. The first earthing is done in May end in 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 something effect. However, weeds can effectively be controlled by spraying 200 g/karnal of Atrazine in 25-30 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 symptom 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 sets. Only one ratoon should be taken and the succeeding rations 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 sets. Apply ½ N 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.

5.2 SAFFRON

CULTIVATION OF SAFFRON: Saffron plays an important role in economy of Jammu and Kashmir state. It is grown in an area of about 3785 ha with an estimated annual production of 9.46 MT. The crop is grown in the temperate regions of the state comprising Kashmir Valley and adjoining mountainous regions of Jammu division.

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

SOIL REQUIREMENT: It requires well drained clay loam soils having a pH range of 7-7.5 free from pebbles.

LAND PREPARATION: The land should be ploughed upto a depth of 25-30 cm and subsequently, suckers rhizomes, runners etc. 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: August

PLANTING STOCK: Saffron is planted by dormant corms, select disease free and large sized corms, having at least 2.5 cm diameter. The husk dirt etc. adhering to the corms, should be removed, and the corms before planting should be treated with a dilute solution of Gallol.

SEED RATE: About 2.5-3.0 q corms are required to establish a karnal 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.

FERTILIZER APPLICATION: 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/ha)			Fertilizer (kg/ha)		
N	P	K	Urea	DAP	MOP
20	27.6	18	20	60	33

Urea should be top dressed in the crop during the winter season (December-January). Diammonium Phosphate and Murate of potash should be applied in the month of September with the last inter-cultural 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 interculturalures may be done to remove weeds, mixing of dry leaves in soil and to create soil mulch for conservation of moisture.

DISEASE 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) @ 20 t/ha.
- v) Augmentation of FYM with biocontrol agent (*Trichoderma* spp. @ 1 kg with 20 kg FYM) for soil application.
- vi) Corm treatment with carbendazim 50 WP by dipping the corms in carbendazim (2g/L) solution for 30 min. before sowing.
- vii) Field sanitation by collecting and burning infected plants including corms.

PLANT PROTECTION: For eradication of rats, their holes should be fumigated with Aluminium phosphide tablets.

YIELD: The yield of saffron during the four years is 6-8 kg (1.5-2 kg saffron per annum). Yield during the first year of planting is the lowest.

5.3 ZEERA

It is one of the most important crops of spices. It is used for flavor and in medicines too. In the state of Jammu and Kashmir, it is found in sloppy lands in forests. Keeping in view its properties and importance, its cultivation on scientific lines in Kishtwar in Doda district of Jammu province has been started which is given as under:

CLIMATE: It is usually grown in the forest areas of temperate zone and needs cold climate.

SOIL: Well drained sloppy land. Soil light textured i.e. Sandy to sandy loam.

LAND PREPARATION: Land is ploughed 3-4 times in order to bring the soil to a fine tilth. Small beds of convenient size are made to facilitate sowing.

SOWING: There are two method of sowing:

- a) Through Seed
- b) Through Bulbs
 - 1) Seed prior to sowing is cleaned, mixed with soil then sown in the beds, maintain 30 cm distance between the rows. The seed is then covered with soil. During first three years, bulb formation takes place and crop yields in the fourth year. Full crop yield is obtained in fifth year.
 - 2) With use of bulbs, the crop yields starts within first year of sowing.

SOWING TIME: October-November (for both the methods)

SEED RATE:

- I) Seeds 750-1000 g/karnal
- II) Bulbs 25,000-30,000/ha (The above number of bulbs will be obtained from the seed already mentioned after about four years).

FERTILIZER APPLICATION: Like other crops, this crop too is in need of nutrients and hence the following quantity of fertilizers is recommended:

Nutrient (kg/ha)			Fertilizer (kg/ha)		
N	P	K	Urea	DAP	MOP
20	20	-	26	44	-

In addition 15-20 tonnes/ha well rotten compost is to be added.

INTERCULTURE: One weeding and one hoeing is essential within a year. Weeding in the month of April followed by hoeing in the month of September.

MATURITY AND HARVESTING: Zeera flowers by the end of May-June. Since its seed fall after ripening, its harvesting is done in time with caution.

YIELD:

- I) From Seed: In 4th yearly 40-50 kg/ha.
- II) From Bulbs: 60-80 kg/ha.

PLANT PROTECTION: Blight disease is very common and appears in the month of March and May. For the control of this disease, use carbendazim @ 0.2% as per need.

POINTS TO REMEMBER:

- 1) Land free from water logging.
- 2) Soil light textured, rich in organic matter.
- 3) Addition of liberal quantity of organic matter in the form of FYM/Compost.
- 4) Weeding and hoeing in spring.

6. CULTIVATION OF PADDY STRAW MUSHROOM (*Volvariella* spp.)

INTRODUCTION: Paddy straw mushroom is popularly known as tropical mushroom. It can be grown in neglected rooms or at any shady place where direct sun rays and strong winds do not approach. It requires high temperature for its cultivation i.e. above 30°C and minimum temperature should not fall below 25°C in any case.

TECHNIQUE OF CULTIVATION: Paddy straw of Basmati varieties is preferably needed for its cultivation. Hand threshed paddy straw should be preferred for this purpose. It should be fresh and free from mould and green leafy matter.

PREPARATION OF BUNDLE: Straw bundles of 3-5 kg with both the ends tied are prepared. The unequal protruding parts of the bundles at the shoot end are cut off.

LAYING OF BEDS: The straw bundles are soaked in water for 24 hours. Take out the bundles when they start giving unpleasant smell due to rotting. Wash the bundles with fresh and clean water and place them on a sloppy surface in order to drain off excessive water. Take out seven bundles with butts on one end and place them lengthwise on a raised platform of bricks or bamboo frame supported by bricks. These seven bundles constitute one layer. Similarly 4 more layers of seven bundles each placed in criss-cross fashion, constitute one bed. The ends of the loose straw extending out of the bed, should be cut with a sharp knife or scissors.

SPAWNING: Broadcast the grain spawn manually on the top of 2nd, 3rd and 4th layer, leaving a margin of 6 to 8 cm on each side.

WATERING: Watering should be done twice a day i.e. in the morning and evening. Watering should be adjusted according to local environment conditions. The straw should not become too wet because it starts rotting. 80% humidity is to be maintained during the dry time.

PICKING: Small buttons of mushroom start appearing after 15 days of spawning. As soon as grayish buttons appear, over 80% relative humidity and plenty of fresh air are necessary. Watering the floor twice or thrice a day builds up the required relative humidity. Picking can be done once or twice a day before buttons open out. This can be done by gently twisting the upper end of the fruiting body. Mushrooms continue appearing for 20 days. After 20 days of cropping, replace the straw.

YIELD: Each bed would yield about 3 kgs.

SOWING TIME IN JAMMU PROVINCE (PLAINS): The preparation of beds can be started in plains of Jammu province from 25th of April to 10th of August. During this period three crops can be taken as per the following programme:

FIRST CROP

1. Preparation of beds- 25th of May
2. Cropping period- 10th of June to 30th of June

SECOND CROP

1. Preparation of beds- 31st of June
2. Cropping period- 15th of July to 5th of August

7. APICULTURE

Package of practices for *Varroa destructor*

Description of Varroa mite: The infestation is caused by an ectoparasitic mite (*Varroa destructor* Anderson & Trueman), which sucks the blood of larvae, pupae and adult bees. It is reddish brown measuring 1.1 to 1.2 mm long and 1.5 to 6 mm broad. It has 4 pairs of legs. The female enters the cell with 4-5 days old larvae and lays eggs there. Life cycle is completed in 8 to 10 days in females and 6 to 7 in males. It prefers drone brood over worker brood. Honey bee mites have been extremely destructive to honey bees. In some countries i.e. UK, more than 90% of the beehives have been killed. The varroa mite, *Varroa destructor* is considered the most serious pest of the European honey bee, *Apis mellifera*. 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. Drafting Bees
4. The spread of the varroa mite can also be accelerated by the following ways:
5. Transport of hives by migratory beekeeping.
6. 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.

MITE IS A CARRIER OF SECONDARY INFECTIONS: Vectors of virus infections as deformed wing virus (DWV), acute bee paralysis virus (APV) and slow paralysis virus (SPS) - all RNA viruses that replicate upon injection in bee haemolymph.

SYMPTOMS

1. Adult mite can be seen on bee's 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. Avoid robbing and drifting 0 don't spill sugar syrup in the apiary.
6. Sterilize combs with 80% acetic acid and/or PDB.

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.

**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.***

List of Chemicals

COMMON NAME	TRADE NAME
FUNGICIDES / BACTERICIDES	
Antibiotic (based on Streptomycin Sulphate + Terramycin)	Agrimycin
Antibiotic (Antifungal Antibiotic)	Aureofungin
Antibiotic (based on Streptomycin Sulphate + Tetracycline Hydrochloride)	Streptocycline
Carbendazim	Bavistin
Mancozed + Carbendazim	Saaf companion
Carboxin	Vitavax
Metalaxyl + Mancozeb	Ridimil mz
Copper Oxychloride compound Blue Copper or Blitox	Cuprasol, Fytolon
Zineb	Dithane Z-78
Mancozeb	Dithane- M-45
Ziram	Cuman - L
Metaxyl	Apron, Ridomil
Tricyclazole	Beam 75% WP
Dinocap	Karathane
INSECTICIDES	
Carbofuran	Furadan 3 G
Methyl Parathion	Metacid 50 EC
Carbaryl	Sevin 50 WP
Phorate	Thimet 10 G
Phosphamidon	Dimecron 100 EC
Methyl Odemeton	Metasystox 25 EC
Phosfume Tablet / Phosphide pellets	Aluminium
WEEDICIDES	
Fluchloralin	Basalin
Butachlor	Machete
Atrazine	Atrataf

Performa for Referring Sample to Plant Clinic

S.No.	Particulars	Details
1.	Name & Address of Farmer	
2.	Agro Climatic Zone	Subtropical/ Intermediate/ Temperate
3.	Growing condition	Irrigated/ Rainfed
4.	Source of Irrigation	Canal/ Tube well/ NA
5.	Crop/ Variety/ Stage of crop	
6.	Sowing date	
7.	Package of practice Followed	Fully/ Partial/ Farmer's practice
8.	If partial Strike the practice not followed	
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	<ul style="list-style-type: none"> ▪ Directorate of Extension Education, SKUAST-J, Railway Road, Jammu. ▪ Krishi Vigyan Kendra, R.S. Pura, Jammu. ▪ Krishi Vigyan Kendra, Tandwal, Rajouri. ▪ Krishi Vigyan Kendra, Gowrie, Bhaderwah. ▪ Krishi Vigyan Kendra, Tanda, Udhampur.
27.	Sender's particular with Signatures & date of Submission	

Name & Address: _____

List of Pesticides which are Banned, Refused Registration and Restricted in Use

(As on 20th October 2015)

I. PESTICIDES / FORMULATIONS BANNED IN INDIA

A.	Pesticides Banned for manufacture, import and use.
1.	Aldicarb (vide S.O. 682 (E) dated 17 th July 2001)
2.	Aldrin
3.	Benzene Hexachloride
4.	Calcium Cyanide
5.	Chlorbenzilate (vide S.O. 682 (E) dated 17 th July 2001)
6.	Chlordane
7.	Chlorofenvinphos
8.	Copper Acetoarsenite
9.	Dibromochloropropane (DBCP) (vide S.O. 569 (E) dated 25 th July 1989)
10.	Dieldrin (vide S.O. 682 (E) dated 17 th July 2001)
11.	Endrin
12.	Ethyl Mercury Chloride
13.	Ethyl Parathion
14.	Ethylene Dibromide (EDB) (vide S.O. 682 (E) dated 17 th July 2001)
15.	Heptachlor
16.	Lindane (Gamma-HCH)
17.	Maleic Hydrazide (vide S.O. 682 (E) dated 17 th July 2001)
18.	Menazon
19.	Metoxuron
20.	Nitrofen
21.	Paraquat Dimethyl Sulphate
22.	Pentachloro Nitrobenzene (PCNB) (vide S.O. 569 (E) dated 25 th July 1989)
23.	Pentachlorophenol
24.	Phenyl Mercury Acetate
25.	Sodium Methane Arsonate
26.	Tetradifon
27.	Toxaphene(Camphechlor) (vide S.O. 569 (E) dated 25 th July 1989)
28.	Trichloro acetic acid (TCA) (vide S.O. 682 (E) dated 17 th July 2001)
B.	Pesticide formulations banned for import, manufacture and use
1.	Carbofuron 50% SP (vide S.O. 678 (E) dated 17 th July 2001)
2.	Methomyl 12.5% L
3.	Methomyl 24% formulation
4.	Phosphamidon 85% SL

C.	Pesticide/ Pesticide formulations banned for use but continued to manufacture for export
1.	Captafol 80% Powder (vide S.O. 679 (E) dated 17 th July 2001)
2.	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 24 th September 2014)
8.	Warfarin (vide S.O. 915 (E) dated 15 th June 2006)

II. PESTICIDES REFUSED REGISTRATION

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

III. PESTICIDES RESTRICTED FOR USE IN THE COUNTRY

S.No.	Name of Pesticides	Details of Restrictions
1.	Aluminium Phosphide	<p>The Pest Control Operations with Aluminium Phosphide may be undertaken only by Govt./ Govt. undertakings/ Govt. Organizations/ pest control operators under the strict supervision of Govt. Experts or experts whose expertise is approved by the Plant Protection Advisor to Govt. of India except ¹Aluminium Phosphide 15% 12 g tablet and ²Aluminum Phosphide 6% tablet.</p> <p><i>[RC decision circular F No. 14-11(2)-CIR-II (Vol. II) dated 21-09-1984 and G.S.R. 371(E) dated 20th may 1999]. ¹Decision of 282nd RC held on 02-11-2007 and, ²Decision of 326th RC held on 15-02-2012.</i></p> <p>The production, marketing and use of Aluminium Phosphide tube packs with a capacity of 10 and 20 tablets of 3 g each of Aluminium Phosphide are banned completely.</p> <p>(S.O.677 (E) dated 17th July, 2001)</p>
2.	Captafol	<p>The use of Captafol as foliar spray is banned. Captafol shall be used only as seed dresser. (S.O.569 (E) dated 25th July, 1989)</p> <p>The manufacture of Captafol 80% powder for dry seed treatment (DS) is banned for use in the country except manufacture for export. (S.O.679 (E) dated 17th July, 2001)</p>
3.	Cypermethrin	<p>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]</p>
4.	Dazomet	<p>The use of Dazomet is not permitted on Tea.</p> <p>(S.O.3006 (E) dated 31st Dec, 2008)</p>
5.	Diazinon	<p>Diazinon is banned for use in agriculture except for household use. (S.O.45 (E) dated 08th Jan, 2008)</p>
6.	Dichloro Diphenyl Trichloroethane (DDT)	<p>The use of DDT for the domestic Public Health Programme is restricted up to 10,000 Metric Tonnes per annum, except in case of any major outbreak of epidemic. M/s Hindustan Insecticides Ltd., the sole manufacturer of DDT in the country may manufacture DDT for export to other countries for use in vector control for public health purpose. The export of DDT to Parties and State non-Parties shall be strictly in accordance with the paragraph 2(b) article 3 of the Stockholm Convention on Persistent Organic</p>

		Pollutants (POPs). (S.O.295 (E) dated 8 th 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 26 th May, 1989)
7.	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 03 rd May, 2007)
8.	Fenthion	The use of Fenthion is banned in Agriculture except for locust control, household and public health. (S.O.46 (E) dated 08 th Jan, 2008)
9.	Methoxy Ethyl Mercuric Chloride (MEMC)	The use of MEMC is banned completely except for seed treatment of potato and sugarcane. (S.O.681 (E) dated 17 th July, 2001)
10.	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 20 th May, 1999 and earlier RC decision]
11.	Methyl Parathion	Methyl Parathion 50% EC and 2% DP formulations are banned for use on fruits and vegetables. (S.O.680 (E) dated 17 th July, 2001) The use of Methyl Parathion is permitted only on those crops approved by the Registration Committee where honeybees are not acting as a pollinators. (S.O.658 (E) dated 04 th Sep., 1992.)
12.	Monocrotophos	Monocrotophos is banned for use on vegetables. (S.O.1482 (E) dated 10 th Oct, 2005)
13.	Sodium Cyanide	The use of Sodium Cyanide shall be restricted for Fumigation of Cotton bales under expert supervision approved by the Plant Protection Advisor to Govt. of India. (S.O.569(E) dated 25 th July, 1989)

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

(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.	Ampliomycetes 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.	<i>Bacillus thuringiensis</i> var. sphaericus	1.3% FC	1
17.	<i>Bacillus thuringiensis</i> var.galleriae	1.3% FC	1
18.	<i>Bacillus thuringiensis</i> 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.	Carbaryl	5% DP, 10% DP, 50% WP, 85% WP, 4% Gr., 40% LV, 42% Flow	7
36.	Carbendazim	25% DS, 50% WP, 46.27% SC	3
37.	Carbofuran	3% CG,	1
38.	Carbosulfan	25% DS, 25% EC, 6% Gr.	3
39.	Carboxin	75% WP	1
40.	Carfentrazone-ethyl	40% EC, 40% DF(FI) 53% MUP(FI)	3
41.	Carpropamid	27.8% SC	1
42.	Cartap Hydrochloride	4% Gr., 50% SP, 75% SG	3
43.	Chlopropham	50% HN	1
44.	Chlorantraniliprole	18.5% SC, 0.4% Gr.	2
45.	Chlorfenapyr	10% SC (FI)	1
46.	Chlorfenuron	10% SC(FI)	1
47.	Chlorfluazuron	5% EC w/w, 5% w/v, 5.4% EC(FI)	3
48.	Chlorimuron ethyl	25% WP,	1

49.	Chlormequat Chloride	50% Sol.	1
50.	Chlorothalonil	75% WP	1
51.	Chlorpyrifos	20% EC, 10% Gr., 1.5% DP, 50% EC, 2% RTU	5
52.	Chlorpyrifos Methyl	40% EC	1
53.	Chromafenozide	80% WP	1
54.	Cinmethylen	10% EC	1
55.	Clodinafop-propargyl (Piroxofop-propinyl)	15% WP	1
56.	Clomazone	50% EC	1
57.	Clothianidin	50% WG(FI), 50% WG formulation	2
58.	Copper Hydroxide	77% WP, 53.8% DF(FI)	2
59.	Copper Oxychloride	50% WP, 40% Paste, 5% DP, 50 WG	4
60.	Copper Sulphate	Used as Tech 98% equivalent to cooper content 25% w/w min., 2.62% SC	2
61.	Coumachlor	0.5% CB, 0.025% RB	2
62.	Coumatetralyl	0.75% TP, 0.037% Bait.	2
63.	Cuprous Oxide	4% DP	1
64.	Cyantraniliprole	10.26% OD	1
65.	Cyazofamid	34.5% SC (FI)	1
66.	Cyfluthrin	10% WP, 5% EW,	2
67.	Cyhalofop-butyl	10% EC	1
68.	Cymoxonil	80% WP	1
69.	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
70.	Cyphenothrin	5% EC, 0.15% in combination as Aer., 7.2% VP	3
71.	Dazomet	Dazomet Technical (soil Sterilant GR) not permitted on tea	1
72.	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
73.	Diafenthiuron	50% WP	1

74.	Diazinon*R	25% Micro Encapsulation	1
75.	Dichloro Diphenyl Trichloroethane (DDT)*R	50% WP, 75% WP	2
76.	Dichloropropene and Dichloropropanes mixture (DD Mixture) *(R)	1:1	1
77.	Diclofop-methyl	28% EC	1
78.	Diclosulam	84% WDG(FI)	1
79.	Diclorvos (DDVP)	76% EC	1
80.	Dicofol	18.5% EC	1
81.	Difenoconazole	25% EC, 3% WS	2
82.	Diflubenzuron	25% WP, 2% Tab FI&FIM, 2% Gr, FI&FIM	3
83.	Dimethoate	30% EC	1
84.	Dimethomorph	50% WP	
85.	Dinotefuran	20% SG (F.I.)	1
86.	Dinocap	48% EC	1
87.	Dithianon	75% WP	1
88.	Diuron	80% WP	1
89.	Dodine	65% WP, 50% flow	2
90.	D-trans allethrin	2% Mat, 0.1% coil, 0.1% coil (12 hr.)	3
91.	Edifenphos	50% EC	1
92.	Emamectin Benzoate	5% SG (FI) & (FIM), 1.9% EC	2
93.	Endosulfan*	2% DP, 4% DP, 35% EC, 4% Gr.	4
94.	Ethephon	39% SL, 10% Paste	2
95.	Ethion	50% EC	1
96.	Ethofenprox (Etofenprox)	10% EC	1
97.	Ethoxysulfuron	10% EC, 15% WG(FI)	2
98.	Ethylene Dichloride and Carbon Tetrachloride mixture (EDCT mixture 3:1)	3:1	1
99.	Etoxazole	10% SC(FI)	1
100.	Fenarimol	12% EC	1
101.	Fenazaquin	10 EC	1
102.	Fenitrothion*R	2% Spray, 20% OL (banned in agriculture use except for locust in	2

		scheduled dessert area and public health)	
103.	Fenobucarb (BPMC)	50% EC	1
104.	Fenoxaprop-p-ethyl	10% EC, 9.3% EC, 6.7% EC	3
105.	Fenpropathrin	10% EC, 30% EC	2
106.	Fenpyroximate	5% EC,	1
107.	Fenthion*R	2% Spray (banned in agriculture use except for locust in scheduled dessert area and public health)	1
108.	Fenvalerate	0.4% DP, 20% EC	2
109.	Fipronil	0.3% Gr., 5% SC, 0.05% Gel (Import) & FIM, 80% WG (FI & FIM), 2.92% EC	5
110.	Flonicamide	50% WG	1
111.	Fluazifop-p-butyl	13.4% EC	1
112.	Flubendiamide	39.35% SC, 20% WG	2
113.	Fluchloralin	45% EC	1
114.	Flufenacet	60% WP	1
115.	Flufenoxuron	10% DC	1
116.	Flumite	20% SC	1
117.	Flusilazole	40% EC	1
118.	Fluvalinate	25% EC	1
119.	Forchlorfenuron (CPPU)	0.1%, 0.12% EC (FI)	2
120.	Fosetyl-Al	80% WP	1
121.	Gibberellic Acid	Tech. P, 0.186% SP, 0.001% L	3
122.	Glufosinate Ammonium	13.5% SL	1
123.	Glyphosate	41% SL, 20.2% SL, 5% SL	3
124.	Glyphosate ammonium salt	71% SG	1
125.	Halosulfuron methyl	75% WG(FI)	1
126.	Hexaconazole	5% EC, 5% SC, 2% SC, 75% WG	4
127.	Hexythiazox	5.45% EC	1
128.	Hydrogen cyanamid	49% age, 50% SC	2
129.	Imazethapyr	10% SL, 70% WG (FI)	2
130.	Imidacloprid	17.8% SL, 70% WS, 48% FS, 30.5% SC, 2.5% Gel, 70% WG, 0.3% Gr	7
131.	Imiprothrin	50% MUP	1

132.	Indoxacarb	14.5% SC, 15.8% EC	2
133.	Iprobenfos (Kitazin)	48% EC, 17% Gr.	2
134.	Iprodione	50% WP	1
135.	Isoprothiolane	40% EC	1
136.	Isoproturon	50% WP, 75% WP, 50% Flow	3
137.	Kasugamycin	3% SL	1
138.	Kresoxim-methyl	44.3%(500 g/l)SC	1
139.	Lambda-cyhalothrin	2.43% CS, 5% EC, 10% WP, 2.5% EC, 0.5% Chalk, 22.8% CS(FI), 4.9% CS	7
140.	Lime Sulphur	22% SC	1
141.	Linuron	50% WP	1
142.	Lufenuron	5.4% EC	1
143.	Magnesium phosphide Plates	56% Min. Plates (FI)	1
144.	Malathion	5% DP, 25% WP, 50% EC,0.25% Spray and 96% ULV, 2% Spray, 5% Spray	7
145.	Mancozeb	75% WP, 35% SC, 75% WG	3
146.	Mandipropamid	23.4% SC	1
147.	Mepiquat Chloride	5% AS, 50% TK	2
148.	Metaflumizone	22% SC (FI)	1
149.	Metalaxyl	35% WS, 40% WS	2
150.	Metalaxyl - M	31.8% ES	1
151.	Metaldehyde	2.5% DP	1
152.	Metarhizium Anisopliae	1.15% WP	1
153.	Methabenzthiazuron	70% WP	1
154.	Methomyl	40% SP	1
155.	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 17 th July 2001)	2
156.	Methyl bromide *(R)	99% L, 98% L	2
157.	Methyl chlorophenoxy acetic acid	40% SL or 40% As	1
158.	Methyl Parathion *(R)	2% DP, 50% EC	2
159.	Metiram	70% WG	1
160.	Metofluthrin	5% EC, 0.005% Mosquito Coil	

161.	Metofluthrin	0.005% Mosquito coil, 5% EC	2
162.	Metolachlor	50% EC	1
163.	Metribuzin	70% WP	1
164.	Metsulfuron -methyl	20% WP, 20% WG(FI)	2
165.	Milbemectin	1% EC	1
166.	Monocrotophos*R	36% SL, 15% w/w SG	2
167.	Myclobutanil	15% SG, 10% WP	2
168.	Novaluron	10% EC (FI), 8.8% SC, 10% EC	3
169.	NPV of <i>Helicoverpa armigera</i>	0.43% AS, 2.0% AS	2
170.	NPV of <i>Spodopteralitura</i>	0.5% AS	1
171.	Orthosulfamuron	50% WG	1
172.	Oxadiargyl	80% WP, 6% EC	2
173.	Oxadiazon	25% EC	1
174.	Oxycarboxin	20% EC	1
175.	Oxydemeton-methyl	25% EC	1
176.	Oxyfluorfen	23.5% EC, 0.35% Gr.	2
177.	Paclobutrazol	23% SC(FI), 23% SG	2
178.	Paraquat dichloride	24% SL	1
179.	Penconazole	10% EC	1
180.	Pencycuron	22.9% SC	1
181.	Pendimethalin	30% EC, 5% Gr., 38.7% CS(FI)	3
182.	Penoxsulam	21.7% SC(FI)	1
183.	Permethrin	25% EC, 5% SG., 2% EC, LLIN 2% (FI)	4
184.	Phenthoate	2% DP, 50% EC	2
185.	Phorate	10% CG	1
186.	Phosalone	4% DP, 35% EC	2
187.	Phosphamidon	40% SL,	1
188.	Picoxystrobin	22.52% SC(FI)	1
189.	Pinoxaden	5.1% EC	1
190.	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
191.	Pretilachlor	50% EC, 30.7% w/w EC, 37.0% EW	3
192.	Primiphos-methyl	25% WP, 50% EC, 1% Spray	3

193.	Profenophos	50% EC	1
194.	Prohexadione calcium	10% WG (FI)	1
195.	Propanil	35% EC	1
196.	Propaquizafop	10% EC(FI)	1
197.	Propergite	57% EC	1
198.	Propetamphos	20% EC, 1% Spray	2
199.	Propiconazole	25% EC	1
200.	Propineb	70% WP	1
201.	Propoxur	20% EC, 1% Aer., 2% Aer. 1% HH Spray, 2% Bait	5
202.	Pseudomonas flourosceus	0.5% WP, 1.75% WP, 1% WP	3
203.	Pymetrozine	50% WG(FI)	1
204.	Pyrazosulfuron -ethyl	10% WP, 70% WDG(FI)	2
205.	Pyrethrins (Pyrethrum)	0.2% DP, 2.5% EC, 0.05% Spray, 0.2% PH, 2.0% EC	5
206.	Pyriproxifen	0.5% Gr(FI), 10% EC(FI)	2
207.	Pyrithiobac Sodium	10% EC	1
208.	Pyraclostrobin	20% WG (FI)	1
209.	Quinalphos	1.5% DP, 25% EC, 20% AF	3
210.	Quizalofop ethyl	10% EC, (FI), 5% EC (FI)	1
211.	Quizalofop-p-tefuryl	4% EC (FI)	1
212.	S-Bioallethrin	2.4% mat	1
213.	Sodium Cyanide *(R)	Used as Tech., 96% a.i. min	2
214.	Spinosad	45% SC, 2.5% SC	2
215.	Spiromesifen	22.9% SC	1
216.	Streptomycin + Tetracycline	90: 10 SP	1
217.	Sulfosulfuron	75% WG	1
218.	Sulphur	85% DP, 80% WP, 40% SC, 80% WG/ WDG, 55.16 SC (800 gm/ L) 40% WP, 52% SC	7
219.	Tebuconazole	2.5% DS, 2% DS, 25.9% EC, 25% WG, 5.36% FS, 5.4% FS	6
220.	Tembotrione	34.4% SC	1
221.	Temephos	50% EC, 1% Sand Granules	2
222.	Tetraconazole	3.8% EW (FI)	1

223.	Thiacloprid	21.7% SC	1
224.	Thifluzamide	24% SC	1
225.	Thiobencarb (Benthiocarb)	50% EC, 10% Gr.	2
226.	Thiodicarb	75% WP	1
227.	Thiomethoxam	25% WG, 70% WS, 30% FS	3
228.	Thiometon	25% EC	1
229.	Thiophanate-methyl	70% WP	1
230.	Thiram	80% WP, 40% FS, 75% WS	3
231.	Tolfenpyrad	15%EC	1
232.	Topramizone	336 g/l SC(FI)	1
233.	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
234.	Triadimefon	25% WP	1
235.	Triallate	50% EC	1
236.T	Triasulfuron	20% WG	1
237.	Triazophos	40% EC, 20% EC	2
238.	Trichlorfon	5% DP, 50% EC, 5% Gr.	3
239.	Trichoderma viride	1% WP (CFU 2x10 ⁶ gm/min), 0.5% WP, 5% WP,	2
240.	Tricoderma harzianum	0.5% WS, 2.0% WP	2
241.	Tricoderma viride	1.0% WP	1
242.	Tricontanol	0.05% EC, 0.1% EW, 0.05% GR	3
243.	Tricyclazole	75% WP, 70% WG	2
244.	Tridemorph	80% EC	1
245.	Trifluralin	48% EC	1
246.	Validamycin	3% L	1
247.	Verticillium lecanii	1.15% WP	1
248.	Zinc Phosphide	2% RB, 80% Powder, 1% Bait	2
249.	Zineb	75% WP, 80% WP, 27% Colloidal Suspension	3
250.	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% + Chlorpyrifos 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.	Carbaryl 4% + Gamma BHC 4% Gr.	M/s Avantis Crop Science India Ltd., Mumbai	
7.	Chlorantraniliprole 9.3% + Lambda-cyhalothrin 4.6% ZC	M/s. Syngenta India Ltd.,	
8.	Chlorpyrifos 16% + Alphacypermethrin 1% EC	M/s Acco Industries Ltd., Mumbai	
9.	Chlorpyrifos 50% + Cypermethrin 5% EC	M/s De-Nocil, Mumbai	
10.	Cyfluthrin 0.025% + Tranfluthrin 0.04%	M/s Bayer India	
11.	Cypermethrin 10% +Indoxacarb 10% EC	M/s Gharda Chemicals Limited	
12.	Cypermethrin 3% + Quinalphos 20% EC	M/s United Phosphorus Ltd., Mumbai	
13.	Deltamethrin 0.05% + Allethrin.04% L		
14.	Deltamethrin 0.75% +Endosulfan* 29.75% EC		
15.	Deltamethrin 1% + Triazophos 35% EC		
16.	Diazinon 0.5% + Pyrethrum 0.1% ready to use house hold		
17.	Diflubenzuron 20%+ Deltamethrin 2%SC	M/s. Chemtura Chemicals India Pvt. Ltd., Mumbai	
18.	Endosulfan* 35% + Cypermethrin 5% EC	M/s Excel Industries Ltd., Mumbai	
19.	Ethion 40% + Cypermethrin 5% EC	M/s Rallis India Ltd., Bangalore.	
20.	Ethiprole 40% + Imidacloprid 40% (80% WG)	M/s Bayer Crop Science Ltd, Mumbai	

21.	Fipronil 40% + Imidacloprid 40% WG		
22.	Flubendiamide 4% + Buprofezin 20% SC	M/s Rallis India Ltd. Bangalore	
23.	Imiprothrin 0.05% + Cypermethrin 1.0% CL	M/s Godrej Consumer Products Ltd., Mumbai	
24.	Imiprothrin 0.07% + Cypermethrin 0.20% Aerosol	M/s Godrej Consumer Products Ltd., Mumbai	
25.	Imiprothrin 0.1% + Cyphenothrin 0.15%		
26.	Indoxacarb 14.5% + Acetamiprid 7.7% SC	M/s Rallis India Ltd., Bangalore	
27.	Methyl bromide 98% + chlorpicrin 2%		
28.	Novaluron 5.25% + Indoxacarb 4.5% SC	M/s Makhteshim Agan India Pvt Ltd, Hyderabad	
29.	Phosalone 24% + Cypermethrin 5% EC	M/s Aventis Cropscience Ltd.	
30.	Phosphamidon 40%+ Imidacloprid 2% SP	M/s United Phosphorus Ltd.	
31.	Profenofos 40% + Cypermethrin 4% EC	M/s Syngenta India Limited, Pune	
32.	Propoxur 0.25% + Cyfluthrin 0.025% Aerosol	M/s Bayer India	
33.	Propoxur 0.5% + Cyfluthrin 0.015% Spray		
34.	Propoxur 0.5% + Cyfluthrin 0.025% Spray,		
35.	Pyriproxyfen 5% + Fenpropathrin 15% EC	M/s Sumitomo Chemical India Pvt. Ltd.	
36.	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 Specialties 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.	Fluocoplid 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% + Difenconazole 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.	Metflufuron 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

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. ORGANOPHOSPHATES																										
Chlorpyrifos				C	C		C			C														C	C	
Diazinon																							C			
Dichlorvos				C	C			C	C		C						C	C						C	C	
Dimethoate	I	C	C	C		C		I	C	C	C		C				C							C		
Etrimpfos				C			C																			
Fenthion					C	C		C	C		C		C				C			C				C		
Formothion			C					C			C						C									
Malathion	C		C	C		C		C	C	C	C		C													
Methamidophos				C											C	C								C		

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									
Carbaryl					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													

Compatibility of Insecticides vs. Biopesticides (Insect Pathogens)

	Bacillus thuringiensis	Beauveria bassiana	Heliothis armigera NPV	Adisura atkinsoni NPV	Spodoptera litura NPV	Trichoplusia in NPV	Pasteuria penetrans
Acephate	C						
Aldicarb	C						C
Carbaryl	C	C					
Carbofuran	C						C
Chlorpyrifos							
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						

