

GRAIN CROPS

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 Requirement: Rice is basically a crop of humid tropics, but it varies widely in physiological adaptability, hence grown successfully both in tropical and temperate conditions upto an altitude of about 2250m above 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 (30⁰-35⁰ C) and slowly declines until maturity. Temperature beyond 30⁰C 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 (22⁰-25⁰C).

Soil Requirements: Rice grows under varied soil conditions. Clay to clay loam soils, which turn into soft mud when puddle and develop cracks on drying, are most suitable for its growth. The rice soils with high percolation rate reduce 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) | 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) | The late maturing varieties mature in 135-140 days and are suitable for sub-tropical areas of Jammu and Kathua districts under assured irrigation conditions. |
| 4. | Rainfed | China-1039 K-39 (SKAU-5) | These are recommended up to 1200 m elevation under rainfed conditions. |

Promising rice based cropping systems

1. Early rice based cropping systems

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| a. | Rice IET-1410 (1 st June to 25 th June transplanting) | Toria local (3 rd week of September) | Wheat late sown variety (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) | Wheat late sown variety (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/Mash Summer fodder PS-16/Pant Jowar PS-7/U-26 Cowpea (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) | Fodder (Mid March onwards) |
| e. | Rice IET-1410 (15 th June to 15 th July) | Berseem (Mid September to end October) | - |
| f. | Rice IET-1410 (1 st week of June) | Cauliflower: Snowball (Mid October) | French beans: Contender (Mid February) |

2. Medium rice based cropping systems

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| a. | Rice (15 th June to 15 th July transplanting) | Wheat timely sown variety (7 th November to 21 st November) | |
| b. | Rice (15 th June to 15 th July transplanting) | Wheat timely sown variety (7 th November to 21 st November) | Moong: PS-16 or PS-17 (15 th April to 21 st April) |
| c. | Rice (15 th June to 15 th July transplanting) | Berseem (Mid September to End October) | |
| d. | Rice PC-19 (1 st week of June) | Peas: Arkal (Mid October to Mid November) | |

3. Late rice based cropping system

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|----|--|---|--|
| a. | Rice (1 st June to 30 th June) | Wheat (7 th Nov. to 21 st November) | |
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4. Rainfed rice based cropping systems

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|----|--|--|--|
| a. | Rice (with the 1 st monsoon shower upto last week of May) | Wheat (November sowing) | |
| b. | Rice (with the 1 st monsoon shower upto last week of May) | Mustard/Gram/lentil (2 nd fortnight of October) | |

Seed Rate: Use 40 Kg of seed per hectare for fine varieties such as IET-1410, Ratna and Tawi (PC-19) and 40-45 Kg per hectare for coarse varieties such as China-1039, K-39 and Jaya. For direct sowing, 75 Kg of seed per hectare is recommended. For hybrids, use seed rate of 15 kg/ha.

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 at the end of 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) | 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 transplanting 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. With a thin layer of soil and irrigate upto 3/4th height of the seed bed. Again irrigate after 05 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 @ 30 kg/ha after the emergence of first leaf in sprouted seeds.
2. In low-lying and water logged areas where thread worms and root weevil are the problems, incorporate Lindane 1.3 D @ 25 kg/ha in the soil at the time of last ploughing.
3. Protect seedlings from leaf hopper and stem borer by applying Phorate 10G @ 10 kg/ha or Carbofuran 3 G @ 20 kg/ha in 5-7.5 cm standing water and keep water standing at least for 72 hours after application or carbaryl 50% WP @ 1 kg/ha when there are 5% dead hearts per sq.m.
4. In case of surface hopper (Tidha) attack, dust the crop with Follidal 2% D @ 20-25 kg/ha in 750 L of water.
5. In case of seedling blight, spray the seedlings in the nursery with Zineb @ 1.5 kg/ha in 750 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. Such stage generally comes in early and medium groups of rice varieties IET-1410, China-1039, Ratna and Tawi in 25 days while in late group (Jaya) it comes in 25-30 days of sowing.

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 constraints, 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 week old |
| 2. | PC-19 | -do- | 6 to 7 week old |

| | | | |
|----|-------------|--------------------------------|-----------------|
| 3. | Jaya | -do- | 7 to 8 week old |
| 4. | Basmati-370 | 1 st week of August | 7 to 8 week old |

LAND PREPARATION:

1. If possible, grow Dhaincha as green manuring crop 1 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. Put water in the field 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.

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) | 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) | 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 wherever deficiency is noticed.
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, alongwith ZnSO₄, remaining N be top dressed in two equal splits-one at mid tillering stage i.e. 25-30 days after transplanting and the other 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.

TRANSPLANTING: - When puddle settles, transplant the seedlings 3 to 5 cm deep. Shallow transplanting ensures better establishment of plants and early tillering. Plant 2-3 seedlings per hill.

Following spacings for different varieties are recommended:-

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|---|---|
| 1) Jaya, China-1039 and China-Mutant K-39 | 20 cm from row to row, 15 cm from plant to plant 15 x 15 cm |
| 11) IET-1410, Ratna and Tawi | 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. Stop irrigation three weeks before harvest for uniform and early ripening of the crop.

INTERCULTURE AND WEED CONTROL:- To remove weeds and 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 herbicides.

1. Apply Butachlor granules 5 G @ 30kg/ha. 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 + Ethoxy sulfuron @ 0.375 + 0.015 kg a.i./ha at 10 DAT.
3. Add 3 litre of Butachlor 50 EC in 150 kg of sand and broadcast in standing water within 2 DAT.

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 ryaee</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. | Field infested with root weevil and thread worm should be treated with Lindane 1.3% D or Chlorpyrifos 1.5 D @ 25 kg/ha at the time of field preparation. OR Apply any of the following granular insecticides in 5-7.5 cm deep standing water |

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| | | 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. | <ol style="list-style-type: none"> 1. Phorate 10 G @ 10 kg/ha 2. Carbofuran 3 G @ 20 kg/ha 3. Lindane 6 G @ 25 kg/ha 4. Chlorpyrifos 10 G @ 10 kg/ha |
| 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 whereas the old ones produce empty ear heads, which turn white and stand erect. The pest is active from July to September. | Apply the following granular insecticides:- Phorate 10 G @ 10 kg/ha. OR Carbofuran 3 G @ 20 kg/ha. Apply the granules in 5-7.5 cm standing water and do not drain or irrigate the fields for 72 hours of application. Spraying 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. | Spray the crop with Endosulfan 35 EC @ 1.5 L/ha or Methyl parathion 50 EC @ 750 ml/ha in 750 L of water when 5-10 insects per hill upto mid-tillering and there after 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 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"> i) If attack of rice hispa (grub) is noticed in nursery stage, clip the affected tips of leaves before transplanting. ii) Spray the crop with Quinaphos 25EC 1 L/ha in 750 L of water when there is one adult grub or one damaged leaf/hill. iii) Use Endosulfan 35 EC @ |

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| | | 1.5 L/ha in 750 L of water. |
| 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. | i) Destroy eggs by scrapping the top soil bunds of field before monsoon. ii) With the onset of monsoon, spray the bunds within the cultivable area with Methylparathion 2% D or Malathion 5% D @ 25 kg/ha. Repeat the spray after 21 days on need basis. |
| 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. | Spray Carbaryl 50% W.P @ 1.5 kg/ha in 750 L of water or spray the crop with Monocrotophos 36 SL @ 750 ml/ha or Chlorpyrifos 20 EC @ 1.5 L/ha. |

II. DISEASES AND THEIR MANAGEMENT

| S.No. | Name of disease and Symptoms | Disease Management |
|-------|--|--|
| 1. | BROWN LEAF-SPOT: - Small necrotic spots surrounded by reddish brown circular margins appear on the leaves and grains. | Seed treatment with Carbendazim @ 2g/kg seed spray the crop with Mancozeb @ 0.25 or Hinosan @ 0.1% at the appearance of disease. |
| 2. | BACTERIAL LEAF BLIGHT: - 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 server cases, dries up completely. In Jammu division, the disease is invariably noticed at the flowering stage. | On appearance of disease, drain the field. Then irrigate with fresh water after four days. Avoid field to field irrigation. Delay the application of urea. Soak the seeds for 12 hr in solution of Streptocycline (2.5g) + Copper oxychloride (25g)/10L of water. Spray the crop with Streptocycline (100g) + Copper Oxychloride (500 g) in 500 L of water at appearance of disease. |
| 3. | BACTERIAL LEAF STREAK: - Small translucent streaks appear in the inter venial areas of the leaf. | Same control measures as above under Bacterial Leaf |

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| | 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. | Blight. |
| 4. | SHEATH BLIGHT: - Causes spots on leaf sheath. Spots are ellipsoid or ovoid at beginning and enlarge afterwards. Centre of spot is grayish white with brown margins. Sclerotia are formed on or near the spot. In field, the spots are usually observed near waterline. | 1. Seed treatment with Carbendazim @ 2g/kg seed. 2. Spray with Carbendazim @ 0.1 % at appearance of disease & at Boot stage. 3. Follow the crop rotation. |
| 5. | SHEATH ROT: - Rot occurs on upper most leaf sheaths enclosing young panicles. Lesions appear oblong to irregular with brown margins and grey centres or grayish brown throughout . Lesions coalesce, whitish powdery growth may be seen in the affected sheaths and young panicles are rotted. | As for sheath blight. |
| 6. | FALSE SMUT: - The disease so far not considered as a serious one, is gradually becoming severe one. In place of normal grains, mehndi coloured smut balls are formed under favourable conditions. Most of the high yielding varieties are attacked and the incidence varies from 5% to 20%. | Spray the crop with copper oxychloride fungicide 0.2% at 50% flowering stage. |
| 7. | Khaira Disease: - Bronze coloured irregular spots appear on the leaves. Disease mainly appear at 15 days after transplanting. | 1. Apply 25 kg Zinc Sulphate in the soil. 2. Spray the crop with solution of 5 kg Zinc Sulphate + 2.5 kg lime in 800 L of water. |

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 | 135-140 days |

RICE CULTIVATION IN TEMPERATE AND SEMI-TEMPERATE REGION 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 ($14^{\circ} - 20^{\circ} \text{C}$) complete the early growth period stage in rising temperature cycle ($20^{\circ} - 25^{\circ} \text{C}$) and after flowering, and completes the growth in declining temperature ($24^{\circ} - 25^{\circ} \text{C}$). For tillering optimum day temperature is 32° to 34°C , low night temperature ($16^{\circ} - 21^{\circ} \text{C}$) 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 REQUIREMENT: - Rice grows on low-lying to upland soils. Clay to clay loam soils which turn into soft mud when puddle 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 84 K 39 (SKAU-5) | Parts of Poonch, Doda, Rajouri, Udhampur and Kathua districts which fall between 900-1500 m height and having Southern aspects. |
| 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) |
| 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.

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|----|-------------|---|
| 1. | 900-1350 m | Rice ----- Wheat Rice -----Sarson/Barley/Lentil Rice -----Oats Rice -----Vegetable peas Rice -----Berseem |
| 2. | 1350-1500 m | Rice -----Sarson/Barley |

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|----|-------------|--|
| | | 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 50 to 60 kg of seed for raising seedlings for transplanting in a hectare.

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 puddle 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 @ 30 kg/ha 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 + Ethoxy sulfuron @ 0.375 + 0.015 kg a.i./ha at 10 DAT.

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

PLANT PROTECTION: -

1. 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: - | -do- |

| | | |
|----|---|--|
| | Same as mentioned under sub-tropical areas | |
| 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 Endosulfan 35 EC @ 1.5 L or Carbaryl 50% W.P. @ 1.5 kg/ha in 750 L of water and direct the spray nozzle into the whorls. |

II. DISEASES: -

| Name of disease and symptoms | Control Measure |
|--|---|
| BLAST: It causes eye shaped spots on the leaves before and after ear emergence. The spots are ashy coloured in the centre and surrounded by brownish margins. In severe cases leaves, leaf sheaths, neck and ear heads are also attacked causing considerable losses. | <ol style="list-style-type: none"> 1. Seed treatment with Carben-dazim @ 2g/kg seed. 2. Spray the crop with Carben-dazim @ 0.2% or Hinosan @ 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.

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. Infact, 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

- (A) **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.
- (B) **Seed rate:** - Use 75 kg/ha seed. It is both for coarse and fine varieties.
- (C) **SPACING:** - 20-25 cm apart in lines.
- (D) **Depth of Sowing:** - 3 to 5 cm
- (E) **Time of Sowing:** - Sowing time is spread over longer period i.e. from 15th May to middle of June before the start of heavy monsoon showers. It varies in relation to variety. Earlier sowing i.e. 1st May will require an additional irrigation. However, the most suitable time of sowing variety-wise is as under: -

| S.No. | Variety | Time of sowing |
|-------|--|---|
| 1. | Jaya, Tawi (PC-19) | 15 th May to 15 th June |
| 2. | IET-1410, Ratna | 15 th May to 15 th June |
| 3. | China-1039 or K-39, any other variety of similar duration. | 1 st June to 4 th July |

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 | 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.

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.

Application of herbicides has about 80% weed control efficiency. The remaining 20% of the weed can be used as folder 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 |50 to 55 q/ha |

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. B-370
 2. Local Basmati
 3. Sanwal Basmati

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 June to 10th of June.

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

| Nutrient (kg/ha) | | | Fertilizer (kg/ha) | | |
|------------------|----|----|--------------------|-----|-----|
| N | P | K | Urea | DAP | MOP |
| 30 | 20 | 10 | 50 | 44 | 16 |

FERTILIZER APPLICATION: - Same as recommended for other 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.

IRRIGATION AND WATER MANAGEMENT: - For Basmati rice, follow the same irrigation practices as recommended for other varieties. However, Basmati rice is suitable for typical water logged area where no drainage facilities are available and where crop remains submerged.

IMPORTANT HINTS FOR MAXIMIZING RICE YIELDS

1. Select suitable variety to grow.
2. Use certified seedlings, 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 time 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.

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 yield is low. The low yield is because of local seeds and traditional agronomical practices. Hybrids and composites are the high yielding varieties of maize, which have the potential of out yielding the local varieties by many folds.

We can boost maize production by adopting the following practices.

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 and interfere with proper pollination, which results in poor grain formation.

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 particularly during the early growth and at flowering stages. Maximum reduction in 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:

GANGA SAFED 2 (GS-2): - This variety is suitable for sub-tropical areas of Jammu Division where maize is preferred. It matures in 95-100 days. This variety is best under the following crop rotation.

1. Maize - Wheat
2. Maize - Toria local----- Wheat HD-1553 (Irrigated areas)
3. Maize - Potato-----Wheat
4. Maize - Sarson-----Moong/Mash
5. Maize - Potato-----Fodder/Moong or Mash

HIM-123: - This variety is suitable for temperate and warm temperate areas.

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 and plains 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 and plains of Jammu.

The above two composites have out yielded local varieties by 50% and are more resistant to diseases than local varieties.

6. **COMPOSITE C-8:** - This variety has creamy white, bold, semiflint to semident grains variety having a yield potential of 55-60 a/ha. It is recommended for mid elevation and plains of Jammu. It can fit into different crop rotations similar to hybrid maize GS-2 under sub-tropical areas 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. It is also suited for hilly regions of Jammu.

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 20 kg of seed/ha for line sown crop. In case of broadcast sowing, use 30 kg of seed/ha.
2. **HILLY AREAS:** - Use 35-40 kg seed/ha.

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 Local tall Him-123 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 m 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. Use of weedicide like atrazine can also be made @ 1 kg a.i./ha.

Sowing may be done with a seed drill (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 |
| 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 |
| 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 $2/3^{\text{rd}}$ 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.

NOTE: Top dressing of urea should always be done in the after noon 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 @ 1.0 kg a.i./ha in 800-1000 L of water should be sprayed on soil surface just after sowing as pre-emergence application to control weeds in the sole crop of maize. Herbicides recommended for maize + pulse intercrops are as follow:

1. Pendimethalin @ 1kg a.i./ha (Pre-emergence)
2. Fluchloralin @ 0.75 kg a.i./ha (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 "Vetter" 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 | 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 @ 25 Kg/ha in the soil with the last ploughing. Where |

| | | |
|----|---|---|
| | actually consumes and thus losses are very heavy. Adults are black in colour with grey spots on the wings. | soil application could not be given spray the crop with Endosulfan 35 E.C. @ 3 L in 1000 L of water per hectare. Spraying should be direct on the soil surface. |
| 2. | <p>MAIZE STEM BORER (<i>Chlopartellus</i>)</p> <p>This is also a very serious pest 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.</p> | <ol style="list-style-type: none"> 1. Uproot the stubbles of previous years crop and burn. Spray the crop with methydemeton 25 E.C. @ 1.125 L/ha in 750 L of water on endosulfan 35 E.C. @ 1.5 L/ha in 750 L of water. 2. Apply granular insecticides to control stem borer, viz phorate 10 G @ 10 kg/ha or carbofuran 3 G @ 20 kg/ha. The granules can be applied with small perforated tins directly into the whorls. |
| 3. | <p>ARMY WORMS: - This pest is prevalent in hilly region of the Jammu division. The caterpillar feed on the leaves at night and rest in whorles during day. In case of severe infestation feeding may be observed during day also.</p> | <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 (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 |

| | | |
|----|--|--|
| | | <p>the bunds and hidden caterpillar be killed as mentioned above.</p> <p>3. Spray the crop with endosulfan 35 EC @ 1.5 L/ha or carbaryl 50% WP @ 1.5 kg/ha in 750 L of water.</p> |
| 4. | <p>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.</p> | <p>1. Spray the crop with Carbaryl 50% WP @ 2 kg/ha in 1000 L of water at tasselling stage or Endosulfan 35 EC @ 2 L/ha in 1000L of water. Since plant height at this stage is maximum, spray should preferably be done with foot or rocking spray pumps.</p> <p>2. Raising 1 to 2 rows of trap crop like bhindi, sunkukera or Arhar around the field and destruction of beetles be done mechanically.</p> |
| 5. | <p>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.</p> | <p>Spray the crop with Dimethoate 30 EC @ or methyl demeton 25 EC @ 1 L/ha in 1000 L of water.</p> |
| 6. | <p>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.</p> | <p>Spray the crop with Carbaryl 50% WP @ 2 kg/ha in 1000 L of water and use foot or rocking spray pumps.</p> <p>Or</p> <p>Endosulfan 35 EC @ 1.5 L in 750 L of water per hectare.</p> |
| 7. | <p>MAIZE JASSIDS: - It is a serious pest of maize in</p> | <p>Spray with Dimethoate 30</p> |

| | | |
|----|--|---|
| | 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. | EC 2 L/ha or Endosulfan 35 EC @ 1.5 L/ha in 750 L of water. |
| 8. | WHITE GRUB: - Adults feed on leaves. Grubs feed on roots, thus up take of nutrients is reduced. | Use Chlorpyrifos 1.5% D or Lindane 1.3% D @ 25 kg/ha or Phorate 10G @ 25 kg/ha. Spray the surrounding area with 0.2% Carbaryl 50% WP @ 4 g in one L of water. |

DISEASES AND THEIR CONTROL

| | | |
|----|--|--|
| 1. | HEAD SMUT: - The whole cob is replaced with a black spore mass and there is complete grain loss. | <ol style="list-style-type: none"> 1. Sanitation 2. Crop rotation for 2-3 years 3. Uproot the affected plants and destroy |
| 2. | COMMON SMUT (<i>U.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 carbendazium @ 2g/kg of seed |
| 3. | STALK ROT: - 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. If need arises drenching near the collar region with mancozeb 2.5 kg + 50 g Streptocycline in 1000 L of water. |
| 4. | LEAF BLIGHT: - Long elliptical greenish brown lesions on leaves. Affected leaves are thin and semi-transparent. Diseased plants look burnt or frost bitten. | <ol style="list-style-type: none"> 1. Clean cultivation always helps to reduce the disease attack. 2. Spray the crop with Zineb @ 0.2% 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 Branker leaves, FYM, Cowpea straw of 1 cm thick layers may be used on the sown rows.
 - ii) Converse soil moisture by laying mulches.
 - iii) Use foliar application of urea (3%) during dry spells.

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 4 to 5 kg of seed/ha

Always use treated seed. Treat the seed with Apron 355D @ 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 intercropped 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 |
| 50 | 30 | 15 |

These nutrients can be had from the following fertilizer combination:

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

Entire quantity of PK 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.

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:

1. INSECTS & PESTS: -

LEAF EATING CATERPILLARS & GRASS HOPPER: - To control the leaf eating caterpillars and grass hoppers which appear periodically, dust the crop with Chlorpyrifos 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 @ 1.25 L in 750 L of water/ha.

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:

GREEN EAR DISEASE OR DOWNY MILDEW: - The leaves of infested 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. The ears of the infected plants are transformed wholly or partly into green heads of small, twisted leafy structures.

CONTROL MEASURE:

1. Rogue out the diseased plants early in the season to prevent secondary infection.
2. The diseased ears should be collected and destroyed by burning.
3. Treat the seed with metalaxyl 35 SD @ 3 gm per kg of seed.
4. Follow 3 to 4 years rotation with other crops.
5. Seed treatment with Carbenazim @ 2g/kg of seed.
6. Grow resistant varieties like WCC 75 etc.
7. Spray the crop 33-35 days after germination with Ridomil mz @ 0.25%.

ERGOT: - At blossoming pinkish or light coloured fluid (honey dew) exudes from spikelets on different parts of the ear. Later dark sticky patches appear on the ear. After fertilization, small dark brown sclerotia appear in place of grains in the glumes. Seed set is poor or is completely inhibited. The ovary is replaced by a fungal mass with many folds on the surface. Ergot plants should not be fed to the cattle as it contains ergotoxine, which is quite harmful for cattle.

Control:

1. Dip the seeds before sowing in 1d0% salt solution and remove the floating sclerotia.
2. Seed treatment with Carbendazim @ 2g/kg of seed.
3. Ergot diseases can be managed by spraying the crop at boot leaf stage with Zineb @ 0.2%.

SMUT: 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.

CONTROL: Seed treatment with Carbenazim or Carboxin @ 2 g/kg of seed.

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.

HYBRID JOWAR

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

SOILS: - Jawar 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 @ 25 kg/ha in the soil at the time of land preparation.

SOWING TIME: - Sow with the first break of monsoon rains.

SEED RATE AND SOWING: - Use 12 ½ kg of seed per ha. 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 or apply full quantity of NPK and 1/3rd of urea as basal dose.

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 Phorate 10 G granules at 10 kg/ha or Carbofuran 3 G granules at 20 kg/ha 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 1.5 kg/ha or Endosulfan 35 EC @ 1.5 L in 750 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 @ 1 L/ha or Dimethoate 30 EC @ 1 L/ha in 750 L of water.

LESSER MILLETS

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 20 kg seed/ha. 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 Chlorpyrifos 1.5% D @ 25 kg/ha before sowing. |

DISEASES AND THEIR CONTROL

| S.No. | Name of insect and symptoms of attack | Control measures |
|-------|---|----------------------------|
| 1. | GRAIN SMUT: Only scattered grains in the | Treat the seed with Captan |

| | | |
|----|---|--|
| | ear are infected. The diseased grains are converted into black powdery mass of the fungus. | or Thiram @ 2 g/kg of seed. |
| 2. | LEAF BLAST: Eye shaped lesions appear on the leaves. The lesions are ashy coloured in the centre and surrounded by brownish margins. | <ol style="list-style-type: none"> 1. Seed treatment with Carbendazim @ 2g/kg seed. 2. Spray the crop with Carbendazim @ 0.2% or Tricyclazole @ 0.06% |
| 3. | DOWNY MILDEW: The leaves are covered by a whitish fungal growth on the lower surface. The infected leaves show discolouration and split into threads seed. Ears are converted into green small leafy structures. | <ol style="list-style-type: none"> 1. Rogue out the diseased plants early in the season and burn them. 2. The diseased ears should be collected and burnt. 3. Seed treatment with Metalaxyl 35 SD @ 3g/kg. 4. Spray the crop with Mancozeb @ 0.2% or Ridomil MZ-72 @ 0.2%. |

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

SEED RATE AND METHOD OF SOWING: - Use 20 kg seed per hectare. 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 @ 25 kg/ha before sowing. |

DISEASES AND THEIR CONTROL

| S.No. | Name of insect and symptoms of attack | Control measures |
|-------|---|---|
| 1. | DOWNY MILDEW: The leaves are covered by a whitish fungal growth on the lower surface. The infected leaves show discolouration and the ears are converted into green structure. The intensity of disease increases with the increase in humidity. | <ol style="list-style-type: none"> 1. Infected plants should be uprooted and burnt. 2. The diseased ears should be collected and burnt. 3. Seed treatment with Apron 35 SD @ 3g/kg. 4. Spray the crop with Mancozeb @ 0.2% or Ridomil MZ-72 @ 0.2%. |
| 2. | LEAF BLAST: Eye shaped lesions are observed on the leaves which increase, coalesce and give a blasted shape. The | <ol style="list-style-type: none"> 1. Treat seed with Carbendazim or Captan or Thiram |

| | | |
|----|---|--|
| | disease increase with the increase in humidity, day temperature of 30° C and lower night temperature. | @ 2g/kg seed. 2. Apply foliar spray of Carbendazim (0.1%) or Tricyclazone @ 0.06% |
| 3. | GRAIN SMUT: Grains in the ear get partly infected. The discoloured grains are converted into a black powdery mass of fungus. | Treat seeds with Captan or Thiram @ 2 g/kg of seed. |

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 @ 20 kg/ha. 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 @ 25 kg/ha before sowing. |
| 2. | TOP SHOOT BORER: It attacks cheena resulting in unfilled grains and sterile panicle | Spray Methyl demeton 25 EC @ 1L/ha |

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. |

OIL SEED CROPS

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 2 to 2 ½ kg of seed per ha. 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 100q of well rotten FYM/Compost/ha 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.

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 @ 25 kg/ha or spray the crop with Carbaryl 50% WP 1.5 kg/ha or Endosulfan 35 EC @ 1.5 L/ha in 750 L 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 Malathion 50 EC @ 1 ml/L of water (0.05%)

DISEASES : PHYLLODY

In case of phyllody, the floral parts are transformed into green leafy structures followed by profuse branching and plants assume a bunchy top and no seed is formed. Rogue out the diseased plants to prevent further spread of the disease.

BACTERIAL BLIGHT: Numerous golden yellow spots appear on leaves and pods. The disease can be controlled by spraying the crop with Copper Oxychloride (0.2%) + 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 pulverised seed bed containing plenty of 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.

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.

LAND PREPARATION: Plough the land with tawi plough and give 2-3 ploughings with desi plough or disc harrow. Each ploughing should be followed by planking.

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 100 kg of pods are sufficient for one hectare.

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 on set 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 |
| | |

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 burry 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:

1. **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 @ 25 kg/ha 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 @ 1 L/ha or Dimethoate 30 EC @ 1 L/ha in 750 L of water. White grub-same as in maize crop.

II. **DISEASES AND THEIR CONTROL:** Among the diseases, Stem rot and Tikka diseases are important.

Seed treatment with Captan or Thiran @ 2.5 g/kg of seed spray the crop with Mancozeb @ 0.2% or Copper Oxychloride @ 0.3% or Carbendazim @ 0.1%.

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

PULSE CROPS

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 kharif 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. |

SEED RATE: Use 15 to 20 kg of seed per ha. 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 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 @ 0.75 kg a.i./ha in 800-1000 L of water as pre-plant incorporation to control weeds in the field or Pendimethalin @ 1 kg a.i./ha 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.

PLANT PROTECTION: Adopt the following measures to control the insect pest and diseases.

i) Mechanical control same as in Til crop.

ii) HAIRY CATERPILLAR: Spray Endosulfan 35 EC @ 15 L/ha or Carbaryl 50% WP @ 1.5 kg/ha in 750 L water.

iii) WHITE FLY: These damage the crop by sucking the cell sap from leaves and pods. White fly also spreads mosaic virus from one plant to another. Spray the crop with Malathion 50 EC @ 1ml/L of water.

LEAF SPOT DISEASES: Spray the crop with Zineb (0.2%) or Mancozeb (0.25%)

VIRUS DISEASES: Remove the infected plants and burn them.

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

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 hilis

SEED RATE: Use 62.5 kg of seed per ha.

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.

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 @ 25 kg/ha or spray the crop with Endosulfan 35 EC @ 1.5 L/ha in 750 L of water. |
| 2. | JASSIDS AND WHITE FLY | Spray the crop with Dimethoate 30 EC @ 1 L ha in 750 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.

COWPEAS

Cowpeas 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 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 20-25 kg/ha seed for pure crop and 10 kg/ha 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.

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 20 kg of maize seed and 1 ½ kg of rajmash seed per ha. 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 crops with 750 L of water/ha in 1000 L of water.

DISEASES: Anthracose, Leaf spot and Rust diseases are most common in rajmash crop and can be controlled by:

1. Seed treatment with Captan or Thiram @ 2.5 g per kg of seed.
2. Spray the crop with Zineb (0.2%). Repeat the spray after 10 days interval if need arises.

FODDER CROPS

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^o 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 15 to 20 kg of seed/ha 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 sub-sequent irrigations are given at 10-15 days interval. At any cost, the soil should be kept moist till satisfactory germination is obtained. Irrigation after every cut is must.

CUTTING AND YIELD: As the crop takes long time to establish, the 1st cut is often delayed and gets ready in 70, 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.

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 udhampur district. It can also be grown successfully on lower hills.

VARIETIES: PUSA, GIANT.N.B-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 18,000-20,000 to plant per hectare 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.

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 nappier 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.

COWPEAS FODDER

It is one of the most important kharif legume containing about 17% protein. It can be grown in combination with Jawar 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: 50-60 KG/HA 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 150.200 q ha.

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

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: 10 kg of seed/ha 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.

JOWAR FODDER

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 cowpes to provide nutritive feed for milch cattle.

SEED RATE AND METHOD OF SOWING: Seed rate varies from 50-60 kg/ha 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.

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 25 to 30 kg of seed/ha.

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.

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 charri, 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 45-50 kg of seed/ha and for mixed sowing fodder with chari, maize, bajra etc. 25 to 30 kg/ha 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.

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: 40-50 kg/ha for fodder & 20-25 kg/ha for seed production.

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

IRRIGATION: 4-5

HARVESTING: 1st 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 Grain: - 100 to 120 kg /ha

MIXED CROPPING: This crop can be grown mixed with other crops like Teosinte + Cowpea or Moong or Guara.

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 7.5 kg/ha 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.

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 30,000 root slips are required to plant an area of one hectare.

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. Chemical fertilizer such as N,P,K at optimum dose. Full dose of P,K and 50% of N be given at time of plantation and rest 50% of N is to be applied in equal split doses after each cutting.

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.

SUBABOL

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

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

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

RECOMMENDED VARIETIES:

- | | |
|----------------------------|---------------|
| a) For fodder tree | Peru type |
| b) For growing as pastures | Hawaiian type |

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

RAISING OF NURSERY: Seedlings can be raised by two ways:-

- (i) Raising of seedlings in polythene bags. The polythene bags (22.5 x 12.5 cm) are filled with the mixture of soil, FYM and sand in proportion of 1:1:1. The seeds are sown 1 cm deep.
- (ii) Raising of seedlings in nursery beds: Seeds are sown in beds, maintaining a distance of 15-20 cm between and 5 to 10 cm within lines.

AFTER CARE IN NURSERY: Regular watering, weeding and hoeing are essential but when seedlings are established, there is no need of watering them.

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

TIME OF PLANTING: February-March and mid June to mid August is the best time for its planting. Six to twelve months old seedlings should be planted at a depth of 45 cm. in case of termite infestation, apply 15 g of Chlorpyrifos/pit. Grass seeds or root slips in lines 30 cm apart in the space between the rows of subabul seedlings can be sown/planted.

PLANTING DISTANCE:-

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

NOTE: 25% Subabul leaves be mixed with other fodders.

FERTILIZER: In normal and fertile soils application of fertilizers is not required. However, if the soil is poor, apply super-phosphate @ 5-10g alongwith 5 kg FYM/Pit.

IRRIGATION: In dry season casual irrigation may be needed. When the trees are established, there is no need of irrigation.

LOPPING: For the use of fodder and fuel, plants can be lopped after two years of their growth, leaving the main and thick branches. All the twigs upto thumb thickness be cut by sharp pruning scissors or with dranti.

YIELD: 120 to 150 q/ha of fodder from grass 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.

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 through out 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 + Cowpeas MP Charri + Cowpeas Cowpeas alone | Mid March onward at two weeks interval | In the field vacated by potato vegetables, sarson and fields | Mid May to Mid July if sowing has been done in intervals |

| | | | | |
|----|--|-----------------------------|--|-----------------|
| | | | otherwise left fallow in rabi | |
| 2. | Maize + Cowpeas MP Charri + Cowpeas Bajra + Cowpeas Cowpeas alone | Mid April | In the fields vacated after early harvesting of wheat crop. | June –July |
| 3. | Hybrid Napier/Sateria 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:

| | | | | |
|----|--|-----------------------------|--|-----------------|
| 1. | MP Charri + Cowpeas | Mid July | Late sowings recommended | Sept.-Oct. |
| 2. | MP Charri seed crop | -do- | After picking seeds from standing crops. | Oct.-Nov. |
| 3. | Teosinte + Cowpeas | 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/Sateria grass | July-August (previous year) | Perennial harvesting should be planned so as to provide green fodder during lean period. | Oct.- Nov. |
| 6. | Lucerne | Oct.-Nov. (previous year) | -do- | October onwards |
| 7. | Turnip + Fodder Rape berseem + Fodder Rape Berseen + Oat | September | Fields vacated earlier from kharif crops. | Nov.-Dec. |

GRASS AND 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 4 to 5 kg/ha of each grass and legume species. For grass alone 6-7 kg/ha 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 | Stylosanthes Humilis, Doliches Lab Labsiratro Stylosanthes | Soo-babool, serier Dhamman Khair, Albizia Banboo etc. |
| 2. | 500-1000 m | Cenchrus, Dicanthium, Deenanath, Napier Seteria | Dojiches Lab- 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 2000m | 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.

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, | Pre-flowering stage |
| Lucerne and Berseem | |

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 pre-dominate. This fermentation is also anaerobic but butyric acid is one of the main products of this fermentation. Butyric acid has a sharp; disagreeable odour and the silage is not relished by animals. In 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.

CASH CROPS

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 46⁰ C enhances its growth and that below 20⁰ C slows down its growth. Low temperature reduces tillering. The temperature range between 25-35⁰ 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

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 hectare (75-80 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 (52⁰ C) for 5-7 minutes. This treatment helps in converting sucrose into glucose and sprouting of relatively large number of buds takes place.

DISEASE/PEST ATTACK: -

- a) **Diseases:** – Dip the sets in 0.1% solution of Carbendazim for 30 minutes.
- b) **Pests:** - Application of lindane 20 EC (5 L in 1500 L of water) over the sets in furrows at the time of planting to prevent attack of termites.

- c) For control of borers, use Phorate 10 G @ 10 kg/ha or spray the crop with Endosulfan 35 EC @ 1.5 L/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 plunger.

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 2 kg a.l/ha of Simazine or Atrazine in 500-600 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 cro and, therefore, its harvesting should be undertaken earlier.

SAFFRON

CULTIVATION OF SAFFRON: - Saffron plays an important role in economy of Jammu and Kashmir state. It is grown in an area of about 4000 hectares with an estimated annual production of 60 q. 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 to September

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 Agallol.

SEED RATE: - About 80 q corms are required to establish a hectare stand under the Berwar method of saffron cultivation.

METHOD OF PLANTING: - The Berwar method of saffron cultivation comprises essentially of charging the soil with two underground layers of corms, one above the other, in a particular geometric way. The first or the ground layer is planted at a depth of 10-12 cm in straight furrows, opened 15 cm apart. Furrows may be opened, either with a plough or manually with hoe. Corms in the furrows are planted at a distance of 7.5 cm from each other. After planting the first or the ground layer, the second or the upper layer are planted 2.5 cm above and each in between the two rows of the ground layer. The upper layer, thus, rests at a depth of 7.5 to 9.5 cm from the surface or the soil. This method of planting is also called the double storey system of saffron cultivation.

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.

PLANT PROTECTION: - Rats are No. 1 enemy of saffron corms. For eradication of rats, their holes should be fumigated with Phosfume tablets. For control of corm rot, treat the corms before planting with 0.1% carbendazim solution. Dip for 30 minutes.

ROTATION: - Saffron under the said intensive programme should be cultivated in a four year short rotation with some salt resistant crop like wheat, barley, oats mustard etc.

YIELD: - A hectare crop grown under the Berwar way produces during the four years, 6-8 kg saffron or 1.5-2 kg saffron per annum. Yield during the first year of planting is the lowest.

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 Kashmr, 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
- a) 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.
- b) 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 15-20 kg/ha
- 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.

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 30⁰ C and minimum temperature should not fall below 25⁰ 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 not be over one year old and be free from mould and green leafy matter.

PREPARATION OF BUNDLE: - Straw bundles are manually prepared. Each bundle weighs 1 to 5 kg and tied at both ends. The unequal protruding parts of the bundles at the shoot end are cut off.

LAYING OF BEDS: - 35 bundles weighing about 50 kg are required for the preparation of one bed. The straw bundles are soaked in water for 24 hours. Take out the bundles after 24 hrs. of soaking when the bundles 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 from 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. Finally the bed is slightly trampled in order to ascertain its proper form.

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. The fresh mushroom should be consumed immediately or can be preserved for 48 hours by keeping them at low temp. of 100 to 150 C. It can easily be dried by keeping them in shade or in the direct sun.

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 April
2. Cropping period - 10th of May to 30th of May

SECOND CROP

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

THIRD CROP

1. Preparation of beds - 6th of July
2. Cropping period - 21st of July to 10th of August

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 floor 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, Udheywala.*****

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 |
| Carboxin | Vitavax |
| Copper Oxychloride compound | Cuprasol, Fytolon |
| Blue Copper or Blitox | |
| Zineb | Dithane Z-78 |
| Mancozole | Dithane-F M-45 |
| Ziram | Cuman – L |

| | |
|--------------|----------------|
| Metaxyl | Apron, Ridomil |
| Tricyclazole | Beam 75% WP |

INSECTICIDES

| | |
|-------------------|------------------|
| Carbofuran | Furadan 3 G |
| Endosulfan | Thiodan 35 EC |
| Methyl Parathion | Metacid 50 EC |
| Carbaryl | Sevin 50 WP |
| Phorate | Thimet 10 G |
| Phosphamidon | Dimecron 100 EC |
| Methyl Odemeton | Metasystox 25 EC |
| Phosfume Tablet | Aluminium |
| Phosphide pellets | |

WEEDICIDES

| | |
|--------------|---------|
| Fluchloralin | Basalin |
| Butachlor | Machete |
| Atrazine | Atrataf |

Annexure-I

PERFORMA FOR REFERRING SAMPLE

TO PLANT CLINIC

| S.No. | Particulars | Details |
|--------------|--------------------------|--------------------------------------|
| 1. | Name & Address of Farmer | |
| 2. | Agro Climatic Zone | Subtropical/Intermediate/Temperature |

| | | |
|-----|--|--|
| 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. Deptt. | |
| 26. | Sample to be sent to | 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:

Annexure-II

LIST OF PESTICIDES/PESTICIDES

FORMULATIONS BANNED IN INDIA

A. Pesticides Banned for manufacture, import and use

1. Aldrin
2. Benzene Hexachloride
3. Calcium Cyanide
4. Chlordane
5. Copper Acetoarsenite
6. Clbromochloropropane
7. Endrin
8. Ethyl Mercury Chloride
9. Ethyl Parathion
10. Heptachlor
11. Menazone
12. Nitrofen
13. Paraquat Dimethyl Sulphate
14. Pentachloro Nitrobenzene
15. Pentachlorophenol
16. Phenyl Mercury Acetate
17. Sodium Methane Arsonate
18. Tetradifon
19. Toxafen
20. Aldicarb
21. Chlorobenzilate
22. Dieldrine
23. Maleic Hydrazide
24. Ethylene Dibromide
25. TCA (Trichloro acetic acid)

B. Pesticide/Pesticide formulations banned for use but their manufacture is allowed for export (2 Nos.)

1. Nicotin Sulfate
2. Captafol 80% Powder

C. Pesticides for which import, manufacture and use are banned (4 Nos.)

2. Methomyl 12.5% L
3. Phosphamidon 85% SL
4. Carbofuron 50% SP

D. Pesticide Withdrawn (7 Nos.)

1. Dalapon
2. Ferbam
3. Formothion
4. Nickel Chloride
5. Paradichlorobenzene (PDCB)
6. Simazine
7. Warfarin

PESTICIDES RESTRICTED FOR USE IN INDIA

| S.No. | Name of Pesticides |
|--------------|---|
| 1 | Aluminium Phosphide |
| 2 | DDT |
| 3 | Lindane |
| 4 | Methyl Bromide |
| 5 | Methyl Parathion |
| 6 | Sodium Cyanide |
| 7 | Methoxy Ethyl Mercuric Chloride (MEMC) |
| 8 | Monocrotophos (ban for use on vegetables) |

LIST OF PESTICIDES REFUSED REGISTRATION

| S.No. | Name of Pesticides |
|--------------|---------------------------|
| 1 | Calcium Arsonate |
| 2 | EPM |
| 3 | Azinphos Methyl |
| 4 | Lead Arsonate |
| 5 | Mevinphos (Phosdrin) |
| 6 | 2,4,5-T |
| 7 | Carbophenothion |
| 8 | Vamidothion |
| 9 | Mephosfolan |
| 10 | Azinphos Ethyl |
| 11 | Binapacryl |

- 12 Dicrotophos
- 13 Thiodemeton/Disulfoton
- 14 Fentin Acetate
- 15 Fentin Hydroxide
- 16 Chinomethionate (Morestan)
- 17 Ammonium Sulphamate
- 18 Leptophos (Phosvel)