1. Paddy

It is the most important staple food crop of Kashmir region. Over a period of time, a number of rice varieties suitable for high as well as low altitude situation, resistant to lodging, diseases and pests have been developed and the full potential of these varieties can be exploited when recommended package of practices are adopted.

1.1 Soil and climate

Rice is adapted to a wide range of soil conditions ranging from loamy sands to heavy clay loams or loams. Day temperature of 25-33 °C and night temperature of 15-20 °C are suitable for optimum growth and higher yield of rice. Heavy winds cause lodging or shattering depending upon crop growth stage.

1.2 Recommended varieties

1.2.1 For lower belts of the Valley

1.2.1.1 China 1007

The variety is recommended for cultivation up to 1650 m amsl. It takes 145-147 days for maturity. This variety is cold tolerant at early growth stage and blast resistant having a yield potential of 5-6 t/ha.

1.2.1.2 China 1039

This is a medium yielding variety recommended for lower belts upto 1650m amsl. This is a cold tolerant variety, but moderately susceptible to blast, low fertilizer responsive and prone to lodging and grain shattering. The variety matures in 135-140 days. Having yield potential 5-5.5 t/ha.

1.2.1.3 K-39

This is a high yielding variety recommended for cultivation upto 1650 m amsl. This variety has good tillering capacity, cold tolerant and lodging resistant with good head rice recovery. The variety matures in about 135-140 days it is moderately resistant to blast under field condition. Its yield potential is 6-6.5 t/ha.

1.2.1.4 Jhelum

A high yielding variety recommended for cultivation in lower belts (upto 1700 m amsl) under irrigated or waterlogged situations released in 1996. The variety possesses good tolerance to cold and better cooking quality but is moderately susceptible to blast. It matures in 135-140 days. Its yield potential is 6.5-7 t/ha.

1.2.1.5 Chenab

Variety recommended for cultivation upto 1650 m amsl and release in 1996. The variety shows tolerance to cold, better phenotypic acceptability and moderate resistance to blast under field condition. It characterized by complete synchronous flowering, matures in 138-140 days and has a yield potential of 6-6.5 t/ha.
1.2.1.6 Shalimar Rice -1

Released in 2005. The variety is recommended for cultivation in areas below 1650 m amsl. The grain is slender with non-glutinous endosperm and non aromatic feature. The variety matures in about 140-145 days and possesses a high yielding capacity of 7.0-7.5 t/ha. It is resistant to blast under field condition.

1.2.2 For higher belts of the valley

1.2.2.1 Kohsaar

A high altitude rice variety recommended for cultivation in areas of 1700-2100 m amsl. It is a pure line variety selected from cross Shinei-Jamna Sari and developed at RRRS Khudwani, SKUAST-K and released in 2001. The variety is cold tolerant particularly at seedling stage, moderately resistant to blast and easy threshability. The variety matures in 135-140 days under high altitude conditions. Its yielding ability is 4-4.5 t/ha. Grain straw ratio of the variety is 0.45.

1.2.2.2 K-332

This is high yielding variety suitable for cultivation in higher belts (above 2000 m amsl) of the Valley. The variety has erect dark leaves, stiff straw and erect flag leaf. It bears dense drooping panicle and easy to thresh. It attains a height of 70 to 80 cm and does not lodge even under heavy soil fertility conditions. The variety matures in about 130-140 days at high altitude and possesses high degree of resistance to blast under field conditions and exceptionally good tolerance to cold at various growth stages. Its yield potential is 4-4.6 t/ha.

1.2.2.3 Barkat

This variety is suitable for higher elevation upto 2000 m amsl. It matures in about 130-140 days and has more head rice recovery. It has high degree of cold tolerance and is moderately susceptible to blast. Its yield potential is 3.8 to 4 t/ha.

1.3 Preparation of nursery

The area of raising nursery should be approximately 1/20th of the area of the field for which seedlings are to be raised for transplanting. The nursery should be well puddled, levelled and free from weeds and the area should have adequate water for irrigation and facilities for drainage.

Plough the nursery area 2-3 times to bring the soil to a fine tilth. Level the soil and let in the water. Puddle the soil properly so that 2-3 cm layer of water is maintained in the nursery bed.

Temperature fluctuation during the month of April and first fortnight of May due to incessant rains can lead to stunted and week rice nursery, and even complete failure of nursery. Therefore, protected nursery can be an alternative to save nursery from climatic vagaries, besides grain yield can increase by 3-4 % through transplanting of healthy seedlings.

1.3.1 Types of nurseries

1.3.1.1 Protected nursery

Polythene sheets are placed on fixed willow sticks over nursery area to make low tunnel temporarily covered with dry soil or pebbles at the edges of the polythene.
Technique

- During day time (sunny days) remove polythene by rolling.
- Keep the nursery covered with polythene on cloudy/rainy day.
- During night hours, for initial 10-15 days, keep nursery covered.
- Once nursery is fully established, cover it only when required depending upon the weather conditions.
- Nursery sowing can be done from last week of April to second week of May.

1.3.1.2 Modified protected nursery

Its medium is prepared with a 20-25 cm layer of soil, sand, organic manure and ash in the ratio of 2:2:1:1, respectively laid on polythene sheet. The above-ground fixtures are same as in case of protected nursery.

1.3.2 Nutrient management

Apply one kg each of N and P₂O₅ and 0.5 kg of K₂O for 100 sq. m area of the nursery bed. Apply one kg of N per 100 sq. m of nursery bed at least 6-10 days before uprooting of the seedlings.

1.3.3 Sowing

Paddy seed should be soaked in water and incubated for 36-48 hours or till it sprouts properly. Broadcast sprouted seed uniformly in the seed bed and maintain 2-3 cm water level till sprouted seeds are established. Control algal growth in the seed bed by avoiding of incorporation of undecomposed materials at the time of nursery bed preparation, proper incorporation of DAP, avoid muddy water for irrigation, drain out water from bed and if necessary apply copper sulphate @ 0.5g + lime 0.5 g/liter of water and drench it after drainage of previous water. In case yellowing of seedlings is noticed, drain out the water for few days or apply 1 kg N/100 sq. m of nursery area.

1.3.4 Sowing time

The usual sowing time in the Valley for paddy nursery is 3rd week of April to middle of May. In order to obtain maximum yield, transplanting of paddy should be completed between last week of May to second week of June. Any delay beyond this period results in the reduction of crop yield. It is better to complete the sowing operation for direct seeded crop by first week of May.

1.3.4 Seed rate

1.3.4.1 For direct seeding

- 80 kg/ha for varieties planted in lower belts.
- 100 kg/ha for varieties planted in higher belts.

1.3.4.2 For transplanted crop

- 50-60 kg/ha for varieties planted in lower belts.
- 80 kg/ha for varieties planted in higher belts.

1.4 Field preparation
The aim of good tillage is to ensure suitable puddling of soil, which can restrict the loss of water due to percolation and consequent loss of applied fertilizers. This will also ensure proper establishment of seedlings for optimum crop stand which in turn will ensure good yields.

Under double cropped areas, plough the land immediately after harvest of the *rabi* crop. Plough in all stubbles, weeds etc. so that they are covered by soil and get decomposed. Plough the land 3-4 times and each ploughing should be followed by clod breaking operation. Incorporate recommended organic manure in the soil. Level the land properly before letting in water. Plaster all bunds with mud to avoid run off of water. Water should be let into the field when it is completely dry. This will help in crumbling of clods, if any. Plough at least once with a ‘Mattiala’, where such a practice is followed as it will help in preparing a proper puddle and reduce percolation.

Under water logged conditions plough the land at least once in autumn after the harvest of paddy crop. About two weeks before transplanting, puddle the soil to minimize percolation. Repair all the bunds so that water level can be maintained in the field. If rat damage has been observed during previous crop, the bunds should be dug up at the beginning of winter. Prepare the bunds afresh when the preparatory tillage is carried out.

### 1.5 Nutrient management

Fertilizers should preferably be applied on soil test basis. However, in absence of soil test, following fertilizer schedule may be adopted:

- Well decomposed FYM or any other organic manure @ 10 t/ha should be well incorporated in the soil at final preparation of land.
- For varieties planted in lower belts
  
  120 kg N, 60 kg P$_2$O$_5$ and 30 kg K$_2$O and 25 kg ZnSO$_4$ per ha, respectively.
- For varieties planted in higher belts
  
  80 kg N, 60 kg P$_2$O$_5$, 30 kg K$_2$O and 15 kg ZnSO$_4$/ha, respectively.

  Half dose of nitrogen along with full dose of P$_2$O$_5$, K$_2$O and ZnSO$_4$ should be applied as basal dose before transplanting. Remaining half dose of nitrogen should be applied in two equal splits; one each at early tillering stage (15-18 DAT) and panicle initiation stage (38-42 DAT).

  If basal application of zinc sulphat is not given or zinc deficiency appears in standing crop then foliar application of zinc sulphat @ 23 g/liter water is sufficient to remove deficiency. In addition to recommended N:P$_2$O$_5$:K$_2$O:ZnSO$_4$, foliar application of boron (borax @ 9.1 g or boric acid 5.9 g/liter water) and molybdenum (ammonium molybdate @ 1.85 g/liter water) may enhance the yield.
As basal application

<table>
<thead>
<tr>
<th>Fertilizers</th>
<th>for varieties planted in lower belts</th>
<th>for varieties planted in higher belts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>For one ha. area</td>
<td>For one kanal area</td>
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<tr>
<td></td>
<td>For one kanal area</td>
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<td></td>
<td>For one kanal area</td>
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<tr>
<td>Urea</td>
<td>80 kg</td>
<td>4 kg</td>
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<tr>
<td>DAP</td>
<td>130 kg</td>
<td>6.5 kg</td>
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<tr>
<td>MOP</td>
<td>51 kg</td>
<td>2.55 kg</td>
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<tr>
<td>ZnSO₄</td>
<td>25 kg</td>
<td>1.25 kg</td>
</tr>
<tr>
<td>As top dose in each split (urea)</td>
<td>65 kg</td>
<td>3.3 kg</td>
</tr>
<tr>
<td>Calcium ammonium nitrate (CAN) against urea</td>
<td>146 kg as basal and 120 kg as top dose in each splits</td>
<td>7.3 kg as basal and 6 kg as top dose in each splits</td>
</tr>
</tbody>
</table>

Note: Under submerged condition nitrate and nitrite converted into nitrogen and nitrous oxide due to denitrification in reduced condition, thus nitrogen losses from urea fertilizer is high by denitrification and leaching. Due to coating of calcium carbonate on granules of CAN fertilizer these losses are neutralized.

For varieties recommended for lower belts a fertilizer dose of 90 kg N, 60 kg P₂O₅ and 30 kg K₂O and 15 kg ZnSO₄ per ha, is recommended under waterlogged conditions. Nitrogen should be applied in three equal splits i.e. 1/3rd as basal, 1/3rd at active tillering and 1/3rd at panicle initiation stage. Full dose of P₂O₅, K₂O and ZnSO₄ be applied as basal and the fertilizers should be mixed with top 10-15 cm soil.

1.6 Transplanting

Transplant 30-35 days old, healthy seedlings (about 20 cm height) at 2-3 seedlings per hill, maintaining a spacing of 15 cm x 15 cm, immediately after uprooting from the nursery. For better tillering the seedlings should be transplanted less than 3 cm deep. Gap filling should be carried out 7-10 days after transplanting. For late transplanting, under unavoidable circumstances (beyond 20th June) and under waterlogged conditions, number of seedlings per hill should be increased to 6.

1.6.1 Care in transplanting

- Avoid over aged (> 35 days) seedlings.
- Avoid deep transplanting and wider spacing (row to row and plant to plant) as both reduce yield.
- Avoid root damage to seedlings during uprooting.
- Avoid wilting of seedlings after uprooting by keeping them in water till they are transplanted.
• Early transplanting (last week of May) is recommended for lower belts of Kashmir and for higher belt (1700-2200 m) in second week of June.
• Modified protected nursery is recommended over traditional nursery.
• 20 days old seedlings are preferred over 30-35 days old seedlings which can be obtained by adopting modified protected nursery.

1.7 Weed management

Weeds can be reduced by proper puddling and water management in paddy. Maintenance of 5 cm water level in paddy fields reduces weed growth to some extent. Weeds can be controlled either by mechanical means or by application of weedicides. Butachlor @ 1.5 kg a.i. per ha is recommended. The chemical should be applied 2-5 days after transplanting. At the time of weedicide application, water level of 3-5 cm maintained in the field and should impounded for at least 4-5 days. It should be followed by hand weeding at 15-20 days after application of weedicide. Wherever incidence of *Potamogeton distinctus* and *Marsilia quadrifolia* or any other broad leaved weed is heavy, the best control is obtained with drainage of water from the field for 6-7 days followed by weeding by padday weeder (taudrigumx, cono-weeder CIAE) or repeated hand weeding.

For direct sowing, apply butachlor @ 1.5 kg a.i/ha 4-6 days after sowing of sprouted seed. Give hand weeding at 12-15 days after application of butachlor.

1.7.1 Caution

• At the time of transplanting avoid weed seedlings which are akin to rice seedling.
• Water should remain in the field for 3-4 days after the application of herbicide.
• Pre-emergence herbicide application should be done within 2-3 days after transplanting for efficient weed control.

1.8 Water management

Proper water management will enable the crop to tiller profusely, increase the fertilizer use efficiency of applied nitrogen, reduce weeds to some extent and reduce overall water requirement. To achieve these objectives, it is necessary to ensure proper level of the field and approximately 3-5 cm water level should be maintained.

To minimize the seepage and deep percolation of water, proper puddling before transplanting of seedlings is necessary. At mid- tillering stage (20-22 DAT), drain out water completely to follow first top dose of nitrogen and hand weeding. Completely drain out water from the field around panicle initiation stage (35-40 DAT) and re-irrigate the crop after hair like cracks appear in the field. After 50-55 DAT, i.e. at pre-heading stage, again drain out water to stimulate heading. From flowering to milk stage, a thin layer of water should be maintained in the field as water stress at flowering stage may drastically reduce the yield. After semi-dough stage (85-90 DAT), follow alternate wetting and drying up to physiological maturity (100 DAT).

In areas of acute water shortage, apply irrigation 4-6 days after the disappearance of ponded water right from transplanting to physiological maturity.

1.8.1 When to drain water

• Prior to top dressing of nitrogen (18-22 and 38-40 DAT) and panicle initiation stage.
• When highly reduced conditions occur.
• About two to three weeks before harvest, depending on whether the soil is light or heavy.

1.9 Harvesting and threshing
• Harvest the paddy crop at physiological maturity stage (22% grain moisture content) to avoid grain shattering.
• Threshing is carried out at 16% grain moisture content and storage done at 12% moisture content.

1.10 Common Diseases of Rice and Their Management
1.10.1 Seedling Diseases

Seedling diseases contribute to poor seedling emergence, uneven stands, and stand failure. Seedling diseases include seed and seedling decay (pre-emergence damping off) and seedling blight (post-emergence damping off). Several soil-borne fungi such as *Rhizoctonia solani*, *Fusarium* spp. and *Cochliobolus miyabeanus* cause damping off while *Sclerotium rolfsii* and water molds, including *Pythium* spp. and *Achlya* spp., also cause stand losses.

Symptoms

1.10.1.1 Seed Rot and Pre-emergence Damping Off:

The failure of seedlings to emerge from soil is the most obvious symptom of seed rot and pre-emergence damping off. Close examination of seedlings may reveal a white cottony mycelial growth in and around the seed coats and emerging seedlings, especially on surface or collar of plumule thereby indicating the attack by water mold(s). The growing points of roots of germinated seedlings show a dark brown discolouration or rot symptoms. In mild attacks, the base of leaf sheath and roots of emerged seedlings show a similar dark brown or reddish-brown rot. The affected seedlings become chlorotic-turn pale yellow and appear stunted and thinner than the healthy ones. The affected seedlings may soon wither and die. The progress of disease symptoms is influenced by weather conditions.

1.10.1.2 Seedling Blight:

Wet and warm conditions favour seedling blight caused by *Sclerotium rolfsii*. In soils infested by the fungus large number of plants may be killed, often along the rows. The disease symptoms include dark-coloured rot on the base of plants and white moldy growth on lower plant parts. Small, round and tan to brown sclerotia (<2 mm in diameter) may be seen attached to the roots and lower leaves near the soil surface. Immediate flooding of fields affected by seedling blight may retard the disease progress.
1.10.2 Rice Blast

Casual Organism: *Pyricularia grisea*

Blast is the principal disease of rice owing to its wide spread distribution and large scale destructive nature, thereby making rice cultivation impossible in many areas despite management efforts.

**Symptoms**

The symptoms appear on all the aerial plant of parts. Depending upon the site of symptom the rice blast is referred as ‘leaf blast’, ‘collar blast’, ‘node blast’ and ‘neck blast’. The lesions first appear on leaves as minute bluish flecks and later assume elliptical shape with more or less pointed ends. The spots increase in size and become spindle-shaped and such lesions seldom appear on leaf sheath. The central portion of lesions becomes water-soaked, pale- or greyish-green or straw coloured and often with dark brown margins. The lesions on stem and grains are darker. On glumes, bluish patches develop under humid weather conditions. When nodes are infected, the sheath pulvinus rots and turns bluish black. On drying nodes often break apart and remains connected by nodal septum only. All parts above the infected node die, and culm usually breaks at the infected node. On rachis, brown to black spots and rings are seen on maturing inflorescence. Panicles and spikelets may show characteristic small spots. The panicle neck becomes shriveled and is often covered with grey fluffy mycelium. If infection occurs earlier to grain formation, the grains shrivel, remain either half-filled or unfilled and panicles remain erect. However, if infection occurs after some grains have formed, the panicles hang down. Necrosis or girdling of neck tissue results in the breaking of panicle and falling of ears. This is the most characteristic symptom and the most dreadful aspect of the disease which causes maximum crop losses. This phase of the disease is called ‘neck blast’ or ‘neck rot’.

1.10.3 Brown Spot or Helminthosporiose Leaf Spot

Casual Organism: *Helminthosporium oryzae*

**Symptoms**

The disease symptoms appear on leaves, glumes, coleoptiles, leaf sheath and panicle branches. On leaves and leaf sheaths the disease appears as typical oval or circular spots. The spot are evenly scattered all over the leaf surface. The spots when fully developed are dark brown to purplish-brown in colour with grayish white center. On susceptible cultivars, the spots are larger and attain a length of 1 cm or more. In severe cases the spots coalesce, cover large
areas and cause leaf withering. On glumes, black or dark brown oval spots develop which generally cover the entire surface. Coleoptiles may become infected from diseased seeds. The spots on coleoptiles are small, brown and circular to oval which rarely become long streaks. The disease causes black discoloration of grains so reduces seed/ grain quality as well as affects the yield.

1.10.4 False Smut or Green Smut

**Causal Organism:** *Ustilaginoidea virens*

**Symptoms**

The disease appears only after flowering and the fungus infects individual grain/florets of panicle and transforms the growth into greenish spore balls of velvety appearance. The spore balls are visible in between the glumes and gradually grow to attain a diameter of 1 cm or more (double the diameter of normal grain). The spore balls enclose the floral parts and are slightly flattened, smooth, yellow in colour and covered by a membrane. The membrane bursts as a result of further growth and the colour of ball becomes orange and later yellowish green or greenish black. When cut open it is white in center. Usually only a few grains in each panicle are infected. The affected florets, besides having smut balls, remain sterile giving chaffiness to the panicle.

1.10.5 Sheath Blight

**Causal Organism:** *Rhizoctonia solani*

**Symptoms**

The disease produces spots on leaf sheath. The spots are at first ellipsoid or oval but somewhat irregular in shape and greenish grey in colour. The spots later become greenish white in centre with brown margins. Sclerotia are formed on or near these spots, which are easily detachable. In field, the spots are usually observed near the waterline. When conditions are favourable for disease development, the infection spreads up to the culm and kills the entire leaf. Across the affected parts a series of copper-coloured bands appear. The disease is also called ‘banded blight’.

1.10.6 Sheath Rot

**Causal Organism:** *Sarocladium oryzae*

**Symptoms**

The rot occurs on upper-most leaf sheath enclosing the young panicles. The disease symptoms initially appear as oblong to somewhat irregular lesions which are 0.5-1.5 cm long. The lesions may either be grayish brown throughout or may have grayish to light brown centres
surrounded by distinct dark reddish brown margins. As the disease progresses, the lesions enlarge, often coalesce and cover most of the leaf sheath. The young panicles either remain within the sheath or emerge partially. An abundant whitish powdery growth may be found inside affected sheaths. The panicles that have not emerged tend to rot, and florets turn red-brown to dark brown. Most grains are sterile, shriveled, partially or completely unfilled and discoloured.

1.10.7 Glume Discolouration

Causal Organisms: Grain discoloration is induced by fungal complex viz., *Helmithosporium oryzae*, *Cercospora* sp., *Fusarium* sp., *Curvularia lunata*, *Alternaria* sp., etc. Causing brown spots when panicles hatch out the disease leads to decrease in the number of filled grains and increase in unfilled grains.

Symptoms

The disease appears initially as darkening of glumes and spikelets usually brown to black in colour. The glumes show rotting symptoms. The disease intensity may range from sporadic discolouration to complete discolouration of whole glumes. Such discolorations appear externally on glumes or internally on kernels, or both. On glumes, the symptoms accordingly vary depending on the type of organisms involved and the magnitude of infection. The disease has shown increasing trend in recent years in the valley. The disease also decreases the seed quality and affects grain quality.

1.10.8 Integrated Disease Management

Most rice diseases can successfully be managed by use of healthy disease-free seed, proper field sanitation, application of balanced fertilizers, adherence to recommended cultural practices and, when necessary, use of biocides.

1.10.8.1 Selection of Seeds

Procure the seeds only from reliable registered seed agency or select only healthy and disease-free mature seeds for future use if taken from one’s own crop.

1.10.8.2 Seed Treatment before Storage

Before storage the seed should be cleaned, properly dried and treated with any one of the following fungicides: Tricyclazole 75 WP @ 0.6 g/ kg seed

- Captan 50 WP @ 3.0 g/ kg seed
• Mancozeb 75 WP @ 3.0 g/ kg seed
• Mancozeb 75 WP @ 2.0 g + Carbendazim 50 WP @ 1 g/ kg seed.

1.10.8.3 Pre-sowing Seed Treatments
In order to minimize the chances of disease spread through seed, it is better to soak the seeds for overnight in either of the following fungicides before sowing:

• Tricyclazole 75 WP @ 60 g/100 liter water
• Ediphenphos 50 EC @ 100 ml/100 liter water

The sprouted seeds should not be treated with any fungicide as it may damage the plumule/ radicle.

1.10.8.4 Management of Disease in Nurseries

• The soil in nursery bed should be well pulverized, puddled and properly leveled, and recommended package of practices may strictly be followed for raising the nursery beds. This shall reduce the chances of disease development in field.
• The seedlings become susceptible to disease and injuries when air and water temperatures greatly vary (particularly cool air and warm water); therefore ensure the supply of lukewarm water to avoid cold injuries.
• Seed treatment with recommended fungicide is essential to minimize seed rot, damping off and seedling blight.
• In case any disease symptom is observed in nursery, fungicidal treatment recommended for foliar spray may be given.
• Before transplantation, dip the seedlings roots in anyone of the following fungicidal suspensions for 10-20 minutes:
  • Tricyclazole 75WP @ 60 g/100 liter water
  • Ediphenphos 50 EC @ 100 ml /100 liter water
• Transplantation of rice seedlings should be done when soil temperature is >15°C and atmospheric temperature >18°C.

1.10.8.5 Management of Diseases in Field
1.10.8.5.1 Field sanitation
• Stubbles and leftover straw should be collected and destroyed (either through burning or deep burial).
• Transport of diseased straw to longer distances should be avoided to minimize disease dispersal.
• Ensure the collection and immediate destruction/burial of diseased (false smut) panicles at proper time.
• Eradicate all the weeds from paddy field as it shall help in the removal of collateral hosts of the pathogens.
• Avoid the flow of irrigation/ rain water from diseased field to disease-free fields.
• Any diseased paddy straw/ stubbles left in the field or after use by cattle should be either destroyed or properly composted.
• Avoid the use of fresh or partially decomposed cattle dung as FYM, particularly the cattle dung received from the cattle fed on disease-infected straw.
• The best way to control blast is to integrate the use of resistant varieties with good cultural practices (proper field selection, seeding rate, fertilization, and flooding).

1.10.8.5.2 Cultural Management

• Strictly adhere to the recommended package of practice regarding land leveling, soil preparation, adequate puddling, plant spacing, fertilizer and manure use, crop rotation, water management and weed- and insect-pest management, etc. as these ensure better plant growth and development thereby help in minimizing the disease.
• Use the recommended dose of fertilizers only as the excessive use of nitrogenous fertilizers makes the plants more susceptible to blast, sheath blight and false smut whereas under dosage of nitrogen promotes brown spot disease.
• Irrigate the fields at appropriate time and never allow the fields to dry.
• Specific and suitable recommended resistant varieties should be cultivated.

1.10.8.5.3 Fungicidal Management

Blast, brown spot and false smut are the most prevalent diseases of rice in Kashmir. In view of the present cropping system, it is impossible to completely eradicate the field inoculum even after taking all the precautionary measures. As a result blast incidence is inevitable. Besides pre-sowing seed treatment and seedlings dip as discussed above, the standing crop may be
sprayed with fungicides no sooner the first disease symptoms appear in the field followed by three more sprays at 15-20 days interval. However, keeping in view the devastating nature of these diseases fungicidal sprays at the following four stages of crop growth are necessary to effectively control blast and other rice diseases.

- 1st spray at tillering stage
- 2nd spray at panicle initiation stage
- 3rd spray at booting stage
- 4th spray at milking or dough stage.

1.10.8.5.4 The sprays of any of the following fungicides are recommended:
- Ediphenphos 50 EC @ 100 ml/ 100 liter water
- Tricyclazole 75 WP @ 60 g/ 100 liter of water
- Isoprothiolane 48 EC @ 100 ml/ 100 liter water
- Hexaconazole 5 EC @ 30 – 50 ml/ 100 liter water
- Mancozeb 75 WP @ 200 g + Carbendazim 50 WP @ 50 g/ 100 liter water.
- Carbendazim 50 WP @ 50 - 100 g/ 100 liter water
- Propiconazole 50 WP @ 100 ml/ 100 liter water

It is worthwhile to mention here that the spray of same fungicides during a single cropping season should not be repeated.

1.11 COMMON INSECT PESTS OF PADDY AND THEIR MANAGEMENT
1.11.1 Paddy Snails (Lymnae stagnalis and Triops canceriforms)

It is an important mollusc pest at nursery or just at transplanting stage in Kashmir. The pest dislodges germinating seeds, seedlings and destroys the emerging radical, plumule, lacerates tender leaves at water surfaces and nibbles seedlings. The damage is so severe that sometimes all the germinating seedlings may be eaten from the seedling plot and in some cases the growth of seedlings looks patchy. Period of activity remains from April to June.

Management:
- To reduce their population, ducks may be released in the nursery beds before sowing of the seed.
- To prevent entry of snails into the nursery beds, a sieve may be provided at the point of entry of water into the seed bed.
- Water may be drained out of the nursery beds on bright sunny days for 4-5 hours. Before seed sowing, apply mixture of copper sulphate and lime in the ratio of 2:5 @ 10 kg/ha or chlorpyriphos 10 G @ 20 kg/ha, or carbofuran 3G @ 32.5 kg/ha.

1.11.2 Cray fish (*Eocycicus orientalis*)

Cray fish belongs to crustacea and is a fresh water arthropod. Cray fish damages the paddy at nursery stages and just at transplanting. They feed on the roots by pulverizing the soil and dislodge the young seedlings.

**Management:**

Management in case of snails will take care of cray fish also.

1.11.3 Paddy grass hopper (*Oxya nitidula* or *Hieroglyphus banian*)

The damage is more serious on rice in Kashmir particularly in higher belts with sandy loam soils. Both nymphs and adults cause damage by eating the tender ear heads and nibbling at the grains. Defoliation occurs by eating leaves, leaving behind midrib and stalk intact. The nibbling of young florets and gnawing into the base of panicle results in the formation of “white chaffy ears”. The pest is active from July to September.

**Management:**

- Apply carbaryl WP 10% dust to the crop and grassy bunds @ 15-20 kg/ha after 15 days of transplanting in the morning hours. In case population of pests reaches to a level where economic damage is likely to occur, the treatment may be repeated.
- Spray any long residual insecticide like chlorpyriphos 20 EC @ 100 ml/100 lit of water or endosulfan 35 EC @ 140ml/100 lit of water.
- Scrapping of field bunds to ensure cleaning of bunds from grasses and other weeds so that destruction of eggs is ensured.
- After harvesting, the field should be ploughed so that eggs are exposed and destroyed.

1.11.4 Rice Skipper \{*Pelopidas*=(*Parnara*) *mathias*\}

It is a minor pest. The caterpillars damage the foliage. They also fold the leaves longitudinally with the help of silken threads. It is active from May to September.

**Management:**

- Uprooting of the infested plants.

1.11.5 Rice hispa \{*Dicladispa*=(*Hispa*) *armigera*\}

Both the grubs and beetles injure leaves of paddy crop generally prior to flowering. The grub is a miner and remains within the leaf tissue, feeding and creating long irregular white patches on leaves which ultimately turn white and dry up. Adult is also a leaf feeder, feeding on the green portion of leaf, leaving only the epidermal membrane in parallel white lines which ultimately wither.

**Management:**

- Removal and destruction of leaf infested with hispa.
- Spray endosulfan 35 EC 140 ml/ 100 lit of water or dimethoate 30 EC 100ml/ 100 lit of water or phosolone 35 EC 140ml/ 100 lit of water to the crop.
1.12 STRATEGY TO PRODUCE FARMERS OWN SEED IN RICE

The significance of quality seed in agricultural crop production is well recognized. The yield potential of improved rice varieties is realized only when quality seed is made available to the farmers. Rice being a strictly self-pollinated crop is relatively less susceptible to genetic contamination from other varieties compared to cross-pollinated crops like maize. Therefore, the divergence between seed production and normal grain crop production is relatively small, probably no more than roughing and extra care during handling and storage.

Considering the large rice planting area in Kashmir it becomes increasingly difficult to manage quality seed supply to rice farmers in the beginning of each season. Therefore the strategy adopted by the University has been to train and encourage farmers to use their own saved for several years without any significant deterioration in varietal performance. The procedure to produce seed for an area of 4 kanals (0.2 ha) is detailed here under:

1.12.1 Choice of Variety

The rice production area of Kashmir has been very meticulously delineated ecologically into two different zones (i) valley or lower belts (up to 1650 m amsl) and higher belts (1800-2500 m amsl) with one transitional zone (1650 -1800 m amsl) in between. The varietal requirement is different for different zones. However, there can be an overlap of varieties from two zones in the transitional zones with indica varieties more predominant in the areas towards the valley and japonica varieties towards the zone of higher belts.

1.12.2 Selection of seed

Initially certified seed of a particular variety should be used for the production of farmers own saved seed.

1.12.3 Seed rate

Lower belts = 12 kg, Upper belts = 16 Kg, Transitional belt = 12-16 Kg

1.12.4 Nursery area

Lower belts = 100 m², Upper belts = 120 m², Transitional belts = 100-120 m²

1.12.5 Cultural practices

Agronomic practices are, in general, similar to those used in normal grain production. However, deterioration in seed quality may begin at any point from fertilization onward. Seed quality depends on physical conditions the crop is exposed to during its different growth stages, as well as harvesting, processing and storage. High quality seeds are the result of good production practices which include proper maintenance of seed purity, good growing conditions, proper timing of harvesting, appropriate processing during threshing, cleaning and drying, and safe storage.

1.12.6 Field layout (Fig.1)

Fig. 1. Production technology of farmers saved seed.
During transplanting the main field, select fertile 50 m² area, hence forth called seed plot, with good irrigation and drainage facility away from water inlet and trees, preferably in the middle of the field near a bund. Plant single seedling/hill in lines with a spacing of 20 cm between rows and 15 cm between plants within rows management.

1.12.7 Water Management
To be able to manage water, the field must be levelled and bunds or leaves well maintained. Uniform water depth across field will contribute to more uniform crop, higher seed yield and consistent moisture content in the grain. Reducing variation in moisture content reduces the chances of seed damage from diseases.

1.12.8 Nutrient management
The application of the correct level and type of fertilizer for variety and growing conditions is essential. The prudent application of N is essential to get an even maturing crop with full grain size. Excessive and uneven application can stimulate late tiller production which matures late compared to main culm. This results in higher moisture content that increase the chances of spoilage by diseases. Conversely in sufficient nitrogen can lead to reduced grain size and poor vigour.

1.12.9 Disease management
Paddy blast has been found to be of frequent occurrence under Kashmir condition. Therefore, an integrated approach has to be followed to check the disease which include use of disease free/treated seed, field sanitation, proper weed control and use of fungicides when disease appears in the field, crop should be sprayed with tricyclozole (0.1%), carbendazim (0.1%), ediphenphos (0.1%) or carbendazim (1g) + mancozeb (2g)/liter of water.

1.12.10 Rouging:
The seed plot should be regularly and keenly monitored to identify and remove off types. Characteristics that can be used to determine purity in the seed plot include height, pubescence, awn characteristics and flowering time. Rouging should be done at least once before flowering and once after flowering. If an off type is found after flowering one plant next to it on each side should not be included in the seed.

1.12.11 Harvesting
The optimum stage to harvest seed is between 20-25 % grain moisture (when 80-85 % of grain is straw coloured and the grains in the lower part of the panicle are in the hard dough stage). If crop harvested too late, many grains are lost through shattering. Over drying may result in cracked seed. Cracked seed will not germinate. If harvested early, there will be many immature seed grain and this will reduce quality. The seed plot should be harvested and threshed first to avoid any chance of admixture.

1.12.12 Drying
Sundry the seed to 14% moisture as soon as possible after threshing. Dry the seed to 12% or less moisture content for safe storage. While sun drying the seed should be spread in thin layers (50-100 mm) on the pad or floor and tuned or stirred 7-8 times per day. This will increase the rate of drying besides avoiding sun cracking.

1.12.13 Cleaning
Threshed seed should be cleaned (Winnowed) to remove all kind of trash. Any chipped or diseased/discoloured seed is removed by hand.

1.12.14 Seed treatment
Treat the seed with any of the following fungicides so as to disinfest and disinfect it from seed borne or soil borne pathogenic micro-organism. Captan or thiram @ 3 g or carbendazim @ 2 g or tricyclozole @ 1 g/kg seed.

**1.12.15 Storage**

Store the seed in good containers in cool and dry place and away from rodents till the planting. During the next season half of the seed is sown and next half is retained to meet any eventuality. The process is repeated for 4-5 seasons before procuring fresh certified seed.