

### **Package of practices (PoP) of Paddy**

#### **Crop-Paddy**

**Botanical name-***Oryza sativa* (Family: Gramineae)



**Climate:** Paddy is adopted under wide range of soils, better performance under heavy neutral soils (clay, clay loam and loamy) with good water holding capacity. For better crop growth climatic condition requires with a wide range of temperature from 20 °C -35 °C.

**Fertilizer:** Recommended dose of fertilizers @90:60:60 (upland), 100:60:60 (lowland &Hilly region), N:P:K, Kg./ha. Hybrid Rice @ 120-150 kg N+ 60 kg P<sub>2</sub>O<sub>5</sub> + 60 kg K<sub>2</sub>O / ha + 25 kg ZnSO<sub>4</sub> / ha.

**Sowing:** Optimum sowing time-last week of May to first week of June, subject to availability of moisture/rainfall. Basmati sowing is from 20<sup>th</sup> June to 15<sup>th</sup> July.

**Sowing method:** Following two methods are commonly practiced:

(a) **Direct seeding or Broadcasting method:** In this method seed is directly sown in unpuddled and puddle field prepared for sowing at appropriate moisture level.

(b) **Transplanting method:** In this method a nursery is prepared for transplanting of rice as required for the methods of transplanting. For manual transplanting the nursery is prepared in 1/20<sup>th</sup> of transplanting usually on raised beds. For mechanical transplanting the nursery is raised as mat or tray nursery. The 25 days old seedlings ( 4-5 leaf stage) uprooted from the nursery – bed are transplanted 3-4 cm deep following 20cm x 10cm spacing with 2-3 seedlings/ hill in the line planting and 10cm x15 cm in random planting.

**Sowing Time:** The rice is grown almost in all crop seasons ie Kharif, Rabi and summer in the country. However, depending upon the prevailing weather, it is sown in different periods in different regions.

**Seed Rate:** Optimum seed rate of 50 kg/ha for upland, 25 kg/ha for lowland and hilly region.

**Water management:** **Uniform** leveling of field and proper drainage are most essential for an effective water management in irrigated field. It is ideal to maintain 2-5 cm water throughout the

growing season. Water should be drained out before top-dressing of fertilizer and let in 24 hours later.

**Resistant Varieties:** For **Stem Borer:** Ratna,Vikas,Saket-4,Green Leaf Hopper: ADT-38,IR-50,IR-24, **Gall Midge:** Gauri,Lalat,MDU-3, **Blast:**Rasi,Rasmi,KRH-2, **Bacterial Leaf blight:** Karjat-1,PR4-41,PR-110,Sheath **Blight:** ASD-18,ADT-39, **Rice Tungro Virus:** ASD-15,Ratna,Saket-4,IR-34.

**Weed management:** The problem of weeds is less in puddled fields but it is high in unpuddled fields. Some herbicides such as Anilophos, Butachlor, Anilophos+Ethoxysulfuron, Pyrosulfuron-ethyl, Almix +Butachlor, Fentrazamide , Cinmethyline + 2,4D are used.

**Diseases and their control:**

Diseases	Control
Khaira	5kg zinc with 2.5 kg lime(in 1000 liters of water ) / ha 10 days after transplanting
Blast	Seed treatment with thiram @ 2.5g/kg of seed or tricyclazole 75 wp @ 1.5 g/ kg of seed
Brown spot	Carbendazim 50wp @ 2.0 g/kg seed or Mancozeb 75wp @ 2.5g/kg
Bacterial Leaf Blight (BLB)	Seed treatment with streptocycline (1g) + carbendazim 50 W.P. (20g) for 8–10 kg of seed in 10 litres of water for 12 – 15 hours

**Insects and their control:**

Insects	Control
Gundhi bug	Spray carbaryl 50 wp @ 1,500 g/ha during afternoon hours
Stem Borer/ Leaf Folder	Spray Cartap 50 wp @ 800 g/ha or chlorpyriphos 20EC 2,000 ml/ha
Brown plant hopper	Spray Imidacloprid 200Sl@125 ml/ha or Thiomethoxam @ 50g/ha

**Harvesting and threshing:** The crop should be harvested when the grains turn yellow, moisture content is below 25 %.

**Yield:** Average yield of rice varieties in case of upland rice is 2.0-2.5 tonnes/ha, lowland rice 4.5-5.0 tonnes/ha, hilly region 3.0-3.5 tonnes/ha. With respect to rice hybrids in irrigated ecology is 5.5-6.0 tonnes/ha.

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### **Package of Practices (PoP) of Wheat**

**Crop: Wheat**

**Botanical name: *Triticum aestivum***



**Climate:** Wheat requires well drained and clayey loam soil. However, good crop of wheat can be raised in sandy loam and black soil also. In India wheat is a winter (*rabi*) crop.

**Seed rate:** For medium sized grain varieties Seed rate of 100 kg/ha, for bold seeded variety 125 kg/ha and for late sown seed rate of 125-150 kg/ha is recommended.

**Spacing:** Spacing of 22.5 cm is considered optimum for irrigated timely sown wheat, for irrigated late sowing spacing is reduced to 15-18 cm.

**Land preparation and tillage technology:** A brief description of which is given hereunder;

**Laser land levelling:** This is a precursor resource conservation technology that is a must for the proper implementation of other RCT's for greater productivity and profitability. This technology increases productivity, saves water and other inputs, enhances factor productivity and reduce costs of production.

**Surface seeding:** This RCT is specifically suited to single crop *diara* lands of Eastern parts of India (Eastern UP, Bihar, Assam and West Bengal) where soil remains wet after rice harvesting. The technology requires no tillage, broadcast dry or soaked seed under saturated condition, scope in areas where soil remains wet after rice harvesting and doubles the cropping intensity

**Zero tillage:** This is the most widely adopted RCT covering about 3 million hectares in rice-wheat system of Indo-Gangetic plains and potential to extend to other areas. The main features of the technology are direct drilling in untilled condition, advances sowing time, seeding at comparatively lower as well as higher moisture, saves more than 90 % fuel energy and time compared to practices followed during nineties and similar or higher yield at lower cost.

**FIRBS-Furrow Irrigated Raised Bed-planting System:** This RCT is specifically suited to areas of water scarcity. The water saved can help in bringing more area under irrigation resulting in boosting the production. This is mainly tested in the North Western parts of India (Punjab, Haryana, Western UP) and has given similar yield in case of wheat but 10 to 30% higher yields in case of oilseeds and pulses. This technology saves seed and fertiliser nitrogen by about 25%,

lowers water requirement by about 30%, less weed population on bed tops, diversification of rice-wheat system and less lodging.

**Rotary tillage:** This technology also tested in the North-Western parts of India especially Haryana for growing wheat crop and has potential to be extended to other parts and other crops. The main features of the technology are single pass soil pulverisation and ferti-seed drilling, saves more than 80% fuel energy and time, produces more at lower cost, the modified machine called as Rotary Disc Drill can seed into loose residues and comparatively costly farm equipment.

### Crop Protection Packages

1. For control of **loose smut** and **flag smut**, seed treatment with carboxin (75 WP) @ 2.5 g/kg seed) or carbendazim (50 WP) @ 2.5 g/kg seed or tebuconazole (2DS) @ 1.25g/kg seed) or a combination of a reduced dosage of carboxin (75 WP) @ 1.25g/kg seed and a bioagent fungus, *Trichoderma viride* @ 4 g/kg seed is recommended. Farmers should avoid using the seed from the infected fields.
2. The **yellow rust** may be controlled using recently released resistant wheat varieties. Susceptible wheat varieties may be sprayed with propiconazole or tebuconazole
3. The **powdery mildew**, **brown rust** and **spot blotch** may also be controlled with the foliar sprays of propiconazole @ 0.1%.
4. The **Karnal bunt** may be controlled in seed plots by spraying crop at boot leaf stage by propiconazole @ 0.1%.
5. In the **termite** prone areas, seed treatment with chlorpyrifos @ 0.9g a.i /kg seed, be taken up for their management. Seed treatment with thiamethoxam 70WS (Cruiser 70WS) @ 0.7 g a.i./kg seed.
6. Crop planted under FIRBS is more prone to **root aphid** and **termite** attack while zero tillage shows less termite damage. Hence proper attention should be given in crop planted under FIRBS.
7. **Aphid control:** Imidacloprid 17.8 SL @ 100ml/ha as foliar spray for the control of foliar aphids on need based conditions when the population reaches more than 10 aphids per tiller or 5 aphids per ear head.

**Irrigation:** Wheat sown under irrigated conditions requires 4 to 6 irrigations depending on the soil and weather conditions. If water is available for only 1 irrigation, it should be applied at crown root initiation stage (CRI). If water is available for 2 irrigations, it should be applied at CRI and boot leaf stage.

**Weed Control:** For the control of broadleaved weeds 2,4-D at 500 g/ha or metsulfuron at 4 g/ha or carfentrazone at 20 g/ha can be sprayed using about 300 litres of water/ha. For the control of grasses isoproturon at 1000 g should be used. For the control of complex weed flora combination of isoproturon with 2,4-D or metsulfuron, or sulfosulfuron with metsulfuron can be applied at 30-35 DAS at sufficient soil moisture.

**Yield:** Under irrigated conditions the yield may vary from 2.5 to 6.5 tonnes /ha depending upon practices followed.

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**Package of practices (PoP) of Pigeonpea /Redgram /Arhar**

**Crop-Pigeonpea**

**Botanical name-*Cajanus cajan***



**Soil and climate:** Pigeonpea is cultivated in wide range of climatic conditions in tropical and subtropical areas with a temperature range of 20°-40°C. It is hardy to both low (5" 10°C) and high temperatures up to 40°C. The plant is sensitive to frost during all stages of its growth.

**Sowing Time:** It is sown in the first week of June in Punjab and Haryana and in the second fortnight of June in Uttar Pradesh and northern Rajasthan. Early planting ensures timely sowing of succeeding wheat crop. The medium and long duration pigeonpea is sown with the onset of monsoon, preferably by the first week of July.

**Sowing Method and Seed Rate:** Sowing pigeonpea on ridges is recommended as it facilitates proper drainage and ensure good plant stand. The seed rate for short duration pigeonpea is 15-18 kg/ha, whereas for long duration, it is 10-12 kg/ha. Seed treatment with Rhizobium culture is beneficial.

**Fertilizer Application :** The recommended fertilizer dose is 15-20 kg N, 40-60 kg P<sub>2</sub>O<sub>5</sub>, 20 kg K<sub>2</sub>O and 20 kg S/ ha. Use of PSB culture improves the available phosphorus status in the soil. In addition, application of 15 kg ZnSO<sub>4</sub>, 10 kg borax, 1 kg sodium molybdate, and 1 kg Fe/ha is also recommended for proper growth of plants and higher yield.

**Spacing :** The row-to-row and plant-to-plant spacings for short duration pigeonpea and pre-rabi crop are 50 cm x 15 cm and 30 cm x 10 cm, whereas for medium and long duration varieties, 60 cm x 20 cm and 75 cm x 25 cm respectively.

**Weed Control:** Hand weeding at 30-45 days after sowing or pre-emergence application of Pendimethalin @ 1-1.5 kg/ha provides effective control of weeds.

**Harvesting:** Short duration varieties are harvested in the middle or end of November, whereas medium and long duration varieties by January-March. When more than 80% pods are mature, the plants are cut close to the ground and bundled.

**Yield:** The average yield of sole short duration pigeonpea is 1,200-1,500 kg/ha and that of long duration pigeonpea is 1,800 to 2,500 kg/ha.

**Integrated pest management:** The major diseases of pigeonpea are **wilt**; **sterility mosaic** and **Phytophthora stem blight**. Use of resistant varieties is the best option in disease-prone areas. The key insect -pests in short duration pigeonpea are **pod borer** (*Helicoverpa armigera*), **spotted borer** (*Maruca vitrata*) and **leaf tier** (*Eucosma critica*) whereas in medium and long duration pigeonpea, **pod-fly** (*Melanagromyza obtusa*) and **pod-borer** (*Helicoverpa*) are the major pests. The integrated pest-management strategy consists of cultural, mechanical, biological and chemical control measures.

**Varieties:** The *short duration* varieties, e.g. Pusa 992, UPAS 120, Manak, Paras, ICPL 151 and AL 201, are suitable for rotation with wheat. **Wilt-resistant** varieties are: Asha (ICPL 87119), BDN 1, BDN 2, C 11, JA 4, TT 6, BSMR 853, JA 4, MA 3, MA 6, Narendra Arhar 1, Maruti (ICP 8863), BSMR 736 etc. Short duration *hybrid*, GTH 1 has been released and notified for cultivation in Central India. This is the world's first CMS-based hybrid.

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### **Package of practices (PoP) of Blackgram**

**Crop-Blackgram**

**Botanical name-*Vigna mungo***



**Climate:** During kharif, it is cultivated throughout the country. It is best suited to rice fallows during rabi in southern and south-eastern parts of India. Blackgram needs relatively heavier soils than greengram.

**Soil:** Well-drained, moisture retentive, deep loam soils free from excessive soluble salts and sodicity are ideal. The crop, however, thrives well on marginal lands and protects eroded soils. It is grown as a rainfed crop in the warm plains as well as in the foot-hills and up to an altitude of 2,000 m.

**Sowing time:** Optimum sowing time mid June subject to availability of moisture/rainfall.

**Seed Rate:** Seed rate is 15-20 kg/ha for kharif and 25-30 kg/ha for spring or rabi.

**Spacing:** Row-to-row distance is 30-35 cm for kharif and 25 cm for rabi or spring.

**Harvesting and yield:** The yield is around 10-12 q/ha. Timely harvesting of the crop, when 80% of the pods is matures is recommended to avoid shattering.

**Integrated pest management:** The major diseases are yellow mosaic in northern plains and powdery mildew in southern and south-eastern regions (in rabi). To control insect and pest, yellow mosaic virus, application of Phorate in soil before or at sowing @ 1 kg/ha is required.

**Varieties:** The *powdery mildew*-resistant variety LBG 17 is suitable for rabi in southern zone, and varieties. PDU 1 and Mash 414 are suitable for spring season. Use of resistant varieties like *Yellow Mosaic Virus* (YMV): Pant U-19, Pant U -30 Sarala, Jawahar urd-2, Teja (LBG-20), ADT-4 *Powdery Mildew* (PM): TAU-2, IPU 02-43, Stem fly: KBG-512, *Cercospora leaf spot* (CLS): Jawahar urd-2, Jawahar urd- 3.

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### **Package of practices (PoP) of Greengram**

**Crop-Greengram**

**Botanical name- *Vigna radiata***



**Climate:** Being a tropical crop it cannot tolerate low temperature. It thrives well at 25°-35°C. In northern plains, it can be grown in spring, summer and kharif whereas in southern parts it can be grown throughout the year as the variation in temperature is not much.

**Soils:** Greengram is cultivated on a wide variety of soils, ranging from sandy to heavy loam. Deep, well-drained loam soils of the alluvial tracts are, however, ideal. It is very sensitive to water logging.

**Sowing time:** The sowing time is the first fortnight of March for the spring greengram, last week of March to first fortnight of April for the summer crop. In kharif, seed is sown with the onset of monsoon, preferably third week of June to mid-July. In rabi, seed can be sown from September to December or January, depending on the time of rice harvest and availability of irrigation.

**Seed Rate:** The seed rate is 25-30 kg/ha for spring or summer and 15-20 kg/ha for kharif and rabi.

**Fertilization:** Foliar spray of 2% urea at flowering enhances grain yield under rainfed conditions and also in rice fallows.

**Weed Control:** The control of weeds during 30-40 days after sowing is very beneficial. The young crop is given one hand-weeding or hoeing. Use of weedicide Pendimethalin @ 1.0-1.5 kg a.i./ha immediately after sowing is also useful.

**Harvesting:** The crop matures in 75-85 days in kharif and 65-70 days in spring season. It is harvested when more than 80% pods mature.

**Yield:** The average yield varies from 6 to 8 q/ha. However, yields up to 10-15 q/ha can be obtained with better management.

**Integrated pest management:** The major diseases of greengram *yellow mosaic* virus (MYMV), *Cercospora leaf spot*, *powdery mildew* and *Macrophomina blight*. Yellow mosaic is a major disease in northern and central parts, and powdery mildew in southern parts. The important *insect -pests* are jassids, whitefly, stemfly, hairy caterpillar and thrips. The integrated pest management strategy consists of cultural, mechanical, biological and chemical control measures.

**Varieties:** Use of *yellow mosaic virus* (YMV) resistant varieties like: ML-131, Pant mung- 2, Pant mung-3, ML-267, AAU-34, LGG-450, Madhira-295, Lam-407, Gujarat mung-3, TMB-37, HUM-16, KM-2241, **Powdery mildew** (PM): MH2-15 (Sattya), CLS: COGG-912, Pant mung-6, CLV: Pant mung-6.

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**Package of practices (PoP) of Chikpea or Bengal gram**

**Crop-** Chikpea or Bengal gram

**Botanical name-***Cicer arietinum*



**Climate:** It requires cool climate for its growth and development and high temperature for its maturity. However, severe cold and frost at the time of flowering causes flower drop. The optimum temperature for its growth ranges from 15° to 25°C.

**Soil:** Bengal gram is grown in well-drained, sandy-loam to deep loam soils of medium fertility. The alluvial soils of the Indo-Gangetic belt support a bumper crop of Bengal gram.

**Sowing Time:** In rainfed situation, second fortnight of October and in irrigated situation last week of October to second week of November are the proper sowing times. Recently, a few varieties have been developed that can be sown up to the second week of December.

**Fertilization:** it does not require a large quantity of nitrogen; a small starter dose (15-20 kg/ha) is required. Seed treatment with Rhizobium culture is beneficial. On soils with low to medium phosphorus status, crop responds to phosphatic fertilizer up to 60 kg P<sub>2</sub>O<sub>5</sub>/ha. Phosphate-solubilizing bacteria (PSB) have been found effective.

On soils in exchangeable potash and sulphur, application of 30-40 kg K<sub>2</sub>O and 20 kg S/ha is necessary to obtain good yields. In addition, application of 15 kg ZnSO<sub>4</sub>/ha, 10 kg borax/ha, 1 kg sodium molybdate, and 1 kg Fe/ha is also recommended for soils deficient in these nutrients. Foliar application of 2% urea or DAP at flowering and early podding improves yield rainfed and late sown crop.

**Spacing:** The crop is sown in rows, 30-45 cm apart. Seeds are placed 7-10 cm deep in soil; the rate depends on seed size from 60 to 100 kg/ha. Planting on raised beds (67.5 cm width) accommodating 2 rows is beneficial especially on heavy-textured soils.

**Weed Control:** One hand-weeding 30-40 days after sowing or pre-emergence application of weedicide Pendimethalin @ 1 kg a.i./ha is recommended for effective control of the weeds.

**Irrigation:** The crop responds to irrigation 45 days after sowing and at the early podding stage. In the absence of winter rains, irrigation is beneficial.

**Yield:** In northern plains, the crop matures in 150-160 days, whereas in Central and South Zones, it matures in 120-125 days. Under irrigated conditions, it yields 1,500 to 2,000 kg of grains/ha but up to 3,000 kg/ha may be obtained under favorable conditions.

**Integrated pest management:** **Pod-borer** is the major pest. It requires regular monitoring from flowering onward for eggs and larvae. Sex-pheromone traps (5 traps/ha) should be installed at flower bud initiation stage. Economic threshold limit may be 1-2 larvae/5 to 10 plants.

**Disease management:** The major diseases are *Ascochyta blight* in North-west plains zone and *wilt* in Central zone. Seed should be treated with fungicides viz. Carbendazim+Thiram (1 g+2 g/kg) at sowing. Seed-dressing with bioagent *Trichoderma vixens* @ 0.5 g/kg or *T. harzianum* or *T. viride* @ 4 g/kg seed +fungicide Carboxin (Vitavax) @ 1 g/kg seed should be followed.

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### **Package of practices (PoP) of Lentil**

#### **Crop-Lentil**

#### **Botanical name-*Lens culinaris***



**Climate:** Its range of cultivation extends to an altitude of 3,500 m in north-west hills. The optimum temperature for its growth and development ranges from 15 to 25 C.

**Soil:** Lentil is grown on a wide range of soils ranging from light loamy sand to heavy clay soil in northern parts, and in moderately deep, light black soil in Madhya Pradesh and Maharashtra.

**Fertilization:** The recommended dose of fertilizers is 20 kg N, 40 Kg P<sub>2</sub>O<sub>5</sub> 20 kg K<sub>2</sub>O and 20 kg S/ha. In soils, low in Zn, soil application of 20 kg ZnSO<sub>4</sub> is recommended under rainfed and late sown condition; foliar spray of 2% urea improves yield.

**Sowing Time:** The seed is sown in the second fortnight of October under rainfed condition. However, it can be sown in the first week of November in irrigated areas. Under late-sown condition, the seed can be sown up to 15 December.

**Seed Rate:** The seed rate is 30-40 kg/ha for small –seeded varieties and 50-60 kg/ha for bold seeded varieties, and row to-row spacing is 25 cm.

**Weed Control:** One weeding 30-40 days after sowing or use of weedicide (Pendimethalin @ 1.0 1.25 kg/ha) immediately after sowing helps in controlling weeds.

**Irrigation:** In the absence of winter rains, Light irrigation 40-50 days after sowing and at pod-formation stage is beneficial.

**Harvesting:** When more than 80% pods matures; it is cut with a sickle, dried on the threshing floor and threshed by beating with sticks of trampling with bullocks.

**Yield:** The average yield is 8 to 10 q/ha under rainfed and 12-15 q/ha under irrigated condition. Under good management, it may yield up to 20 q/ha.



**Disease and pest management:** The major diseases of lentil are *rust* in northern plain and *wilt* in Central zone. Use of resistant varieties is helpful in controlling the disease. Pest is not a major problem in lentil. In some years *aphid* population rises due to rise in temperature during January of February, and causes heavy damage. Spray of Monocrotophos (0.04%) is effective for aphid control.

**Varieties:** Use of resistant varieties like *small seeded Rust resistant*: PL-406, PL-639, PL- 4, and L-4147 *bold seeded Rust resistant*: L-4076, DPL-15, IPL-406, DPL-62 etc.

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**Package of practices (PoP) of Pea/Field Pea/ Graden Pea**

**Crop-Pea**

**Botanical name-***Pisum sativum*



**Soil and climate:** This crop grows best in areas having 15°-25°C for 4-5 months. It can be grown on a variety of soils; however, deep loamy soils of Indo-Gangetic plains are the best. The crop can withstand mild alkaline conditions but does not thrive well on acidic soils.

**Seed Rate and Sowing:** The seed rate is 70-80 kg/ha. Seed treatment with Rhizobium culture is beneficial. The seed is sown in lines at 30 cm row-to-row distance. Planting on raised beds (67.5 cm wide with 2 rows of pea) improves yield and economizes irrigation water.

**Irrigation:** In the absence of winter rains, irrigations 40-45 days after sowing and at pod-formation stage are required. The crop receiving irrigation remains protected against frost to a greater extent.

**Fertilization :** The recommended dose of fertilizers is 20-40 kg N, 60 kg P<sub>2</sub>O<sub>5</sub>, 20 kg K<sub>2</sub>O and 20 kg S/ha. Use of PSB culture improves the status of available phosphorus in the soil. In addition, application of 15 kg zinc sulphate, 10 kg borax, 1 kg sodium molybdate is beneficial wherever soil is deficient in these micronutrients. Foliar spray of 2% urea at flowering/pod initiation improves yield particularly under late sown conditions.

**Weed Control:** One hand-weeding 30-45 days after sowing or application of Pendimethalin @ 1.0-1.5 kg a.i./ha soon after sowing helps in controlling the weeds. The crop matures in 130-140 days. In dwarf varieties, inter culture operations are convenient.

**Yield:** The average yield under irrigation is 15-20 q/ha. Timely harvesting of the crop, after 130-140 days of sowing is recommended to avoid shattering.

**Disease and pest management:** The major disease of field pea is **powdery mildew**, which causes heavy losses in yield. The varieties resistant to powdery mildew should be used to control

the disease. In some parts of Uttar Pradesh and Bihar, crop is affected by **rust disease**, in those areas rust-tolerant varieties like HUDP 15, IPF 99-25, IPFD 1-10 and IPF 99-13 should be grown. There is no major pest damage in field pea. However, sometimes, crop is affected by **stem-fly**. Seed treatment with Phorate 2% is beneficial.

**Varieties:** Use of resistant varieties like ***Powdery Mildew*** (PM): Rachna, Pant Pea-5, Aparna (HFP-4), Maliviya Matar-2 (HUP-2), JP-885, Shikha (KFP-103), Sapana (KPMR 144-1), KPMR400 (Indra), Pant Pea-13, ***Rust tolerant***: Malviya Matar-15(HUDP- 15), IPFD 1-10 (Prakash), Pant Pea - 25 etc..

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### Package of Practices (PoP) of Maize

**Crop- Maize**

**Botanical name- *Zea mays L.***



**Climate:** Maize is warm weather crop. Kharif season is the main growing season in northern India. In the south, however, maize may be sown any time from April to October, as the climate is warm even in the winter.

**Soil:** Maize can be grown successfully in wide range of soils ranging from loamy sand to clay loam.

**Variety:** It is always better to select a "Single Cross Hybrid" developed and released for a set of climatic condition. However in areas where, hybrid seed availability cannot be ensured like high altitude and tribal regions, high yield potential composite varieties can be grown. Hybrids of different maturity groups for *Kharif* season, hybrids of late maturity for *Rabi* season and hybrids of early maturity for spring season should be preferred for maize cultivation.

**Time of sowing:** The maize can be grown round the year in all seasons, viz. *Kharif* (monsoon), post-monsoon, *Rabi* (winter) and spring. It is desirable to complete the sowing 12-15 days prior to onset of monsoon.

**Seed rate and plant geometry:** The seed rate depends on purpose, seed size, plant type, season, sowing methods, planter etc. For different purposes of maize cultivation, the following crop geometry and seed rate should be adopted.

#### **Seed rate and plant geometry of maize for different purposes**

<b>Purpose</b>	<b>Seed rate (Kg/ha)</b>	<b>Plant geometry (row x plant, cm)</b>	<b>Plant Population</b>
Grain (normal, QPM)	20	60 x 20	83,333
		75x 20	66,666
Fodder	50	30x10	333,333

**Seed treatment:** To protect the crop from seed and major soil-borne diseases and insect-pests, it is always advisable to treat the seed with fungicides and insecticides before sowing as per the details given as under.

<b>Fungicide/pesticide</b>	<b>Rate of application (g/kg seed)</b>
Bavistinn + Captain in 1:1 ratio	2.0
Apron 35 SD	4.0
Captan	2.5
Imidacloprid	4.0

**Manuring and fertilization:** For higher economic yield of maize, application of 10 tonnes FYM/ha, 10-15 days prior to sowing supplemented with 150-180 Kg N, 70-80 Kg P<sub>2</sub>O<sub>5</sub>, 70-80 Kg K<sub>2</sub>O and 25 Kg ZnSO<sub>4</sub>/ha is recommended. Full doses of P, K and Zn should be applied basal preferably drilling of fertilizers in bands along the seed using seed-cum-fertilizer drills. Nitrogen (N) should be applied in five splits for higher productivity and use efficiency.

**Diseases management :** In India, the major diseases cause an average yield loss of 13.2% of which foliar diseases (5 %), stalk rots, root rots, ear rots (5 %) cause major yield losses. For reduction of incidence of diseases, resistant varieties/hybrids should be grown.

**Harvesting:** Male parent should be harvested first than the female and should be kept separately. Optimum moisture content in grain at harvesting should be around 20%. The harvested cobs should spread evenly instead of making heap.

**Yield:** By adopting package of practices as indicated above; it is possible to obtain 50-60 qtl/ha grain in case of hybrid and 40-50 qtl/ha of grain in case of composites.

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### **Package of Practices (PoP) of Sorghum**

**Crop- Sorghum**

**Botanical name- *Sorghum bicolor* (L.)**



**Soil:** Sorghum is grown in a variety of soils in India. Soils with clay loam or loam texture, having good water retention capacity are best suited for sorghum cultivation. It does well in PH range 6.0 to 8.5 as it tolerates considerable salinity and alkalinity.

**Season:** Being a rain-dependent *Kharif* crop, sowing is best done with the onset of monsoon. In normal season, sowing is completed in July in most of the area. The *Rabi* planting around middle of September is ideal but can be extended up to last week of October.

**Seed rate and spacing:** The plant population of 0.18 to 0.2 million plants/ha is optimum. The recommended spacing to achieve this plant population is 45 cm between rows and 10-12 cm between plants within rows. A seed rate of 8-10 kg/ha is recommended to obtain required plant population.

**Manuring and fertilization:** For sustaining productivity on long-term basis application of farm yard manure @ 10 tonnes/ha, 15 days before to sowing is important. In addition to farm yard manure, application of 60 kg N and 40 kg P<sub>2</sub>O<sub>5</sub>/ha is recommended. To enhance the utilization of applied nitrogen, split application (50% as basal dose and 50% as top-dress) is suggested. However, the P<sub>2</sub>O<sub>5</sub> is to be given as basal dose only.

**Irrigation:** July sown rainy season crop may also need 1-2 irrigations depending upon distribution of rains. For summer sown crop 5-6 irrigations are required due to high evaporative demand of atmosphere. In Southern region *Rabi* season crops needs about 4 irrigations.

**Pest management:** The major pests are *shootfly*, *stem-borer*, *midge* and *earhead bug*. *Shootfly* can be avoided by suitable adjustment of planting time so that the vulnerable stage of crop escapes from shootfly damage. Stem-borer damage which is not serious in most situations can be checked by the application of insecticides, viz. Carbaryl 3 G, Malathion 10 D or Furadan 3 G @ 10-12 kg/ha in the whorl at 30-35 days after germination.

**Disease management:** The disease management involves combination of cultural and chemical control measures, using Aureofungin (200 ppm) and 0.2% Captan during flowering. Spraying Dithane M-45 (2%) 2-3 times during early growth of plants gives good control. Sorghum ***downy mildew*** is commonly prevalent in the transitional belt of Karnataka and Tamil Nadu. Growing of resistant cultivars and clean cultivation can effectively control the disease. Seed dressing with Metalaxyl compounds, viz. Ridomil 25 or Apron 35 sD @ 1 g a.i./kg seed, gives satisfactory control.

**Harvesting and Yield:** Harvesting at physiological maturity is very important to avoid grain mould damage. Average yield is 8-14 qtl/ha.

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### **Package of Practices (PoP) of Pearl Millet**

**Crop- Pearl Millet**

**Botanical name- *Pennisetum glaucum***



**Soil and climate:** The crop is grown mostly during *Kharif* from June to October. However, in Tamil Nadu and Gujarat it is also grown in summer season under irrigation. Crop is grown on a wider range of soils from very light soils on sand dunes in Rajasthan to red loam in Karnataka, Tamil Nadu and parts of Maharashtra and on black soils in Andhra Pradesh, parts of Karnataka and Maharashtra.

**Varieties:** At present, hybrids are grown widely across the states. Some of them are Pusa 23, HHB 67 and ICMH 356. In addition, there are also regionally important hybrids, viz. GHB 558 and GHB 577 in Gujarat; Shraddha and Saburi in Maharashtra; HHB 50, HHB 60, HHB 68 and HHB 94 in Haryana; COH 8 in Tamil Nadu; and RHB 58, RHB 121 and RHB 90 in Rajasthan. The early-maturing hybrids HHB 67, ICMH 356, RHB 121 and GHB 538 have showed promise in many states. Among the varieties, Raj 171, ICMV 221, Pusa Composite 334, Pusa 383 and Samrudhi are popular.

**Sowing time:** Sowing is done normally in June-July with the onset of monsoon in *Kharif*. The *Rabi* crop is planted in October while summer crop is planted in the January-February.

**Seed rate and sowing:** Plant population 0.175 to 0.2 million/ha is optimum for obtaining higher yields. The recommended spacing is 45 cm between rows and 10-12 cm between plants within the row. The seed rate of 5 kg/ha is required to obtain the required crop stand and the seeds are to be drilled at 2 cm depth.

**Manures and fertilizers:** It is important to apply 8-10 tonnes of FYM, as it helps in moisture conservation. As the crop is grown under diverse conditions, from low to high level of management in different states, the manurial requirement also varies accordingly. For example in Rajasthan, where crop is grown under severe drought conditions, application of 20-40 kg N/ha in 2 splits would be sufficient. On the other hand in Gujarat and Haryana and also in Maharashtra, 60-80 kg N/ha would be optimum. In addition, phosphorus and potassium also need to be provided to realize optimum yields.

**Disease and pest management:** Seed treatment with Apron 35 so @ 2 g a.i./kg seeds followed by Metalaxyl spray @ 125 mg a.i./litre of water 20-25 days later will effectively check the disease. Rotation of different hybrids/improved varieties of pearl millet in alternate years is also effective in arresting spread of **downy mildew**. Ergot is another important disease affecting pearl millet. The primary inoculum of the disease is in soil. **White grub** infestation can be managed by mixing of Phorate 10 G or Quinalphos 5 G @ 12 kg/ha with seed and applying in furrows at sowing.

**Harvest and storage:** Pearl millet is harvested when grain moisture is around 20%. Pearl millet grains are prone to spoilage during storage. Hence, it is important to bring down moisture to 12% or less for safe storage. Improved storage structure, viz. metal bins made out of GI sheets, are suitable for safe storage of grains. The pearl millet stover is a valuable feed for cattle.

**Yield:** Under Irrigated condition, Grain-23-35 qtl/ha and Fodder-100-120 qtl/ha. Under Rainfed condition, Grain-12-15 qtl/ha and Fodder-70-75 qtl/ha.

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### **Package of Practices (PoP) of Barely**

**Crop- Barley**

**Botanical name- *Hordeum vulgare L.***



**Climate:** The crop can withstand cool humid and warm dry climates. Barley matures 2-3 weeks earlier than that of wheat and other *Rabi* cereals.

**Soil:** Barley is more tolerant to a saline-alkaline soils and less to acidic soils when compared with other cereals. It is more favored under these conditions in Rajasthan, Haryana, Punjab, Bihar, Uttar Pradesh and West Bengal. It was found to be a successful crop on coastal saline soils of Sunderbans in the West Bengal.

**Varieties:** It is interesting to note that the 2-row malting barley, namely, DWR 28 has been reported to be giving comparable yields with those of the good malting 6-row varieties such as K 551 and RD 2503. Barley gives 5-6 tonnes grain/ha with moderate levels of fertility and irrigation.

**Sowing time:** The normal sowing time extends from middle of October to end of November, depending upon the elevation, temperature, soil type and moisture status. Under rainfed conditions, sowing should be completed by the last week of October, when the mean temperature falls to 23° to 25°C.

**Seed rate:** Seed rate of 75-80 kg/ha may be used for irrigated timely sown, whereas a seed rate of 100 kg/ha is suitable for irrigated late-sown and saline-alkaline soils. For rainfed areas, a seed rate of 80-100 kg/ha should be used depending on soil-moisture status at the sowing. In the cool arid region of Ladakh a higher seed rate of 250-300 kg/ha may be used.

**Seed treatment:** Covered smut and loose smut can be controlled by seed treatment with either of Vitavax, Benlate and Bavistin @ 2 g/kg seed before planting. Dry seed treatment with 0.25% Carboxin would control loose smut. Seed treatment with Vitavax and Thiram in 1:1 ratio or Raxil @ 1.5 g/kg seed, should be used to control the covered smut and **leaf stripe**. Seed treatment with Oxycarboxin 0.25% is recommended for the control of **yellow rust**.



**Manuring and fertilization:** Use, 10-12 cart-loads of decomposed farmyard manure or compost per hectare in poor lands. Agronomic experiments indicate that barley responds well to an application of 40-60 Kg N/ha under rainfed condition and 60-80 Kg N/ha under irrigated condition, depending upon the soil, and variety.

**Diseases and insect-pests management:** **Powdery mildew** caused by *Erysiphe graminis* can be controlled by dusting fine sulphur (200 mesh) @ 15-20 kg/ha or 1% Karathane. *Helminthosporium leaf spot* diseases can be effectively controlled by spraying with copper fungicides or Dithane Z-78. Among the insect-pests, **aphid** (*Rhopalosiphum maidis*) can be controlled by spraying of Methyl demeton 25 EC or Dimethoate 30 EC at 1,000 ml/ha or Imidacloprid 200 SL, at 100 ml/ha in 200-250 litres of water per ha. Systemic granular insecticides, viz. Phorate 10% or Disulfoton 5% should be used in seed furrows @ 0.5 to 1 kg a.i./ha to control the pest.

**Yield:** The average yield of rainfed crop ranges between 2,000 and 2,500 kg/ha, whereas that of irrigated crop is twice as much. Under favorable conditions of manuring and management practices, improved varieties are capable of giving grain yield of 5-6 tonnes/ha under irrigated timely sown conditions, from 3 to 3.5 tonnes/ha under late-sown conditions and from 2.5 to 3 tonnes/ha under rainfed conditions.

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### **Package of Practices (PoP) of Finger Millet**

**Crop- Finger Millet**

**Botanical name- *Eleusine coracana*.**



**Climate & Soil:** It is heat loving plant and for its germination, the minimum temperature required is 8-10 °C. A mean temperature range of 26-29 °C during the growth is the best for proper development and good crop yield. Finger millet can be grown on a wide adaptability to different soil from very poor to very fertile and can tolerate a certain degree of alkalinity.

**Varieties:** A number of high yielding varieties have been evolved and released for cultivation in different states.

**Season:** Finger millet is grown in all the cropping seasons in different parts of the country. More than 90 per cent of the area is under rainfed conditions, grown during *Kharif* season.

**Seed rate and spacing:** Line sowing is ideal and seed drills giving a spacing of 22.5-30 cm between rows should be used. Finger millet seeds are very small (400 seeds/g) and the recommended seed rate of 10 kg/ha will contain about 4 million seeds.

**Manuring and fertilization:** Farmyard manure or compost @ 5 tonnes per ha should be applied 2-3 weeks prior to sowing. Entire  $P_2O_5$  and  $K_2O$  are to be applied at sowing, whereas nitrogen is to be applied in 2 or 3 split doses depending upon moisture availability.

**Diseases management:** The integrated disease management practices include growing resistant varieties, viz. VL 149, GPU 26, GPU 28, GPU 45 and GPU 48. Treating seeds with Thiram or Mancozeb or Carbendazim @ 2 g/kg seed 24 hr before sowing. Sowing early in the season, replacing 25% N with either farmyard manure, compost and biofertilizers reduces the blast severity.

**Harvesting:** The crop matures in about 120-135 days depending on the tract and the variety. The ear heads are harvested with ordinary sickles and straw is cut close to ground.

**Yield:** It is possible to harvest 20-25 qtl/ha of grain and 60-80 qtl/ha of fodder. The Straw of finger millet makes nutritious fodder.

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### **Package of Practices (PoP) of Kodo Millet**

**Crop-** Kodo Millet

**Botanical name-** *Paspalum scrobiculatum*



**Climate:** Kodo is grown mostly in warm and dry climate. It is highly drought tolerant and, therefore, can be grown in areas where rainfall is scanty and erratic.

**Soil:** Kodo is grown from gravelly and stony upland poor soils to loam soils. Deep, loamy, fertile soils, rich in organic matter, are preferred for satisfactory growth. Well-drained soils with adequate moisture supply are required for uninterrupted growth of this crop.

**Season:** Sowing with the onset of monsoon is beneficial. Sowing time extends from middle of June to end of July in different states. The optimum sowing time in Madhya Pradesh and Chhattisgarh which accounts for nearly 80% area under crop in the country is from last week of June to first week of July.

**Varieties:** A number of varieties with high yield potential have been released for different states.

**Spacing and seed rate:** Spacing of 22.5 cm between rows and 10 cm between plants within row is optimum. The seed rate is 10 kg/ha for line sowing and 15 kg/ha for broadcasting.

**Manuring and fertilization:** Besides farmyard manure application, fertilizers @ 40 kg N and 20 kg P<sub>2</sub>O<sub>5</sub>/ha for Tamil Nadu, Madhya Pradesh and Chhattisgarh and @ 20 kg each of NPK/ha for other states are recommended. Treating seeds with *Agrobacterium radiobacter* and *Aspergillus awamori* @ 25 g/kg seed is beneficial.

**Irrigation management:** During dry periods, irrigations are required every 4-7 days depending on the severity of the drought and type of soil. First irrigation at 25-30 DAS and second irrigation at 40-45 DAS. Drainout the excessive rain water from the field during heavy and continuous rains.

**Weed Control:** It is essential to control weeds in the initial stages of plant growth. Generally two weeding at an interval of 15 days are sufficient. Weeding may be done with hand hoe or wheel hoe in line sown crop.

**Diseases management:** **Rust** disease hinders photosynthesis and cause considerable loss in yield. This can be controlled to some extent by spraying of 0.2% solution of Mancozeb 75 WP. Similarly **Head smut** disease can be controlled by seed treated with thiram or ceresan @ 2.5 g/kg of seed and soaking seeds in hot water at 55 °C for 7-12 minutes.

**Harvesting Time:** In Kharif season, the crop becomes ready for harvest in the month of September or October in northern India and in Rabi season, it is harvested from January to February.

**Yield:** With improve package and practices, one can obtain 15-18 quintal grain and 30-40 quintal straw per hectare.

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### **Package of Practices (PoP) of Foxtail Millet**

**Crop- Foxtail Millet**

**Botanical name- *Setaria italica***



**Climate and soil:** Foxtail known for its drought tolerance, it was once an indispensable crop of vast rainfed areas in semi-arid regions in India. At present, foxtail millet is cultivated on a limited area in Andhra Pradesh, Karnataka, Maharashtra, Tamil Nadu, Rajasthan, Madhya Pradesh, Uttar Pradesh and north eastern states. Foxtail grows well on well-drained loamy soils.

**Season:** Optimum time of sowing for rainfed crop is August-September in Tamil Nadu, July-August in Karnataka, first fortnight of July in Andhra Pradesh and second and third week of July in Maharashtra. In Tamil Nadu, *Kharif* irrigated crop is planted from the beginning of June to end of July and summer irrigated crop in January. For plains of Uttar Pradesh and Bihar, middle of June is the optimum sowing time.

**Varieties:** A number of varieties with high yield potential have been released for different states.

**Spacing and seed rate:** Optimum spacing is 25-30 cm between rows and 8-10 cm between plants within a row. The seed rate is 8-10 kg/ha for line sowing and 15 kg/ha for broadcasting.

**Manuring and fertilization:** Apply 5 tonnes of farm yard manure per hectare at 2-3 weeks prior to sowing. Fertilizer required 40: 30:0 kg NPK / ha for Andhra Pradesh, Jharkhand and Tamil Nadu, 30:20:0 kg NPK / ha for other states.

**Inter cropping:** Andhra Pradesh: Foxtail millet+ ground nut (2:1 ratio), Foxtail millet + cotton (5:1 ratio) - Royal seema regions. Finger millet + pigeon pea in 5:1 row ratio.

**Irrigation management:** Kharif sown during Kharif season does not require any irrigation. However, if dry spell prevails for longer period, then first irrigation at 25-30 DAS and second irrigation at 40-45 DAS must be given to boost the yields.



**Weed Control:** Two to three weedings with hand hoe are sufficient to keep the weeds in control. Post-emergence application of 2, 4-D sodium salt (80%) @ 1.0 kg a.i./ha at 20-25 DAS. Isoproturon @ 1.0 kg a.i. /ha as pre-emergence spray is also effective in weeds control.

**Diseases and Insect-pest management:** For **Downy mildew** disease spray of 0.2% solution of Mancozeb 75 WP may help to control the disease and seed treatment is also helps in controlling the disease. To control **Shoot fly**, apply Phorate @ 15 kg/ha (10% granules) in the soil at the time of field preparation or Carbofuran (Furadan) 3% granules @ 30 kg/ha in furrows or as broadcast before sowing.

**Harvesting:** The crop matures in 80-100 days. The crop is harvested when the ear heads are dry, either by cutting the whole plant by sickle or the ears separately. The crop is usually harvested during Kharif season from September to October and Rabi season from January to February.

**Yield:** Grain yield of foxtail millets is 15-18 qtl/ha and Straw yield is 20-40 qtl/ha.

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### Package of Practices (PoP) of Proso Millet

**Crop-** Proso Millet

**Botanical name-** *Panicum miliaceum*



**Climate:** Proso millet is a crop of warm climate. It is highly drought resistant and can be grown in areas where there is scanty rainfall. It can withstand water stagnation also to some extent.

**Soil:** Proso millet can be grown both in rich and poor soils, having variable texture, ranging between sandy loam to clays of black cotton soils, Well drained loam or sandy loam soils free from *Kankar* and rise in organic matter are ideal for proso millet cultivation.

**Varieties:** A number of varieties with high yield potential have been released for different states.

**Season:** The rainy season crop is sown with the onset of monsoon, preferably in July. As late *Kharif* or *Rabi* crop, it is sown in September-October in Tamil Nadu and Andhra Pradesh. In Bihar and Uttar Pradesh as irrigated catch crop, it is sown from mid-March to mid-May.

**Seed rate and spacing:** Proso millet can be sown by broadcasting or drilling seeds in furrows 3-4 centimetre deep. Row to row distance should be kept 25 cm and plant to plant 10 cm. Depending upon the method of sowing, 8-12 kg/ha seed is required. It is desirable that the seed be treated with organo-mercurial compounds like Agrosan G.N. or Ceresan at the rate of 2.5g per Kg of seed before sowing.

**Manuring and fertilization:** To get a good crop, general fertilizer recommendations under irrigated condition are 40-60 kg nitrogen, 30 kg  $P_2O_5$  and 20 kg  $K_2O$  per hectare. Under rainfed condition, fertilizer dose is reduced to half of the irrigated crop.

**Irrigation management:** Proso millet sown during *Kharif* season, generally does not require any irrigation. Summer crop, however, would require two to four irrigations depending upon soil type and climatic conditions.

**Weed Control:** For getting high yield and minimising loss of soil moisture and nutrients, the field should be kept weed-free up to 35 days stage. Post-emergence application of 2,4-D sodium salt (80%) @ 1.0 kg a.i./ha at 20-25 DAS. Isoproturon @ 1.0 kg a.i. /ha as pre-emergence spray is also effective in weeds control.

**Diseases and Insect-pest management:** **Head smut** disease can be controlled by treating seeds with organo-mercurial compounds like Ceresan at the rate of 3g per kg of seed or hot water treatment (soaking seeds in hot water at 55<sup>0</sup>C for 7-12 minutes). For control of **Shoot fly**, apply Phorate @15 kg/ha (10% granules) in the soil at the time of field preparation or Carbofuran (Furadan) 3% granules @ 30 kg/ha in furrows or as broadcast before sowing.

**Harvesting:** Proso millet is ready for harvest after 65-75 days of sowing in most of the varieties. Therefore, the crop should be harvested when about two thirds of seeds are ripe.

**Yield:** With improved package of practices it is possible to harvest 20-23 quintals of grain and 50-60 quintals of straw per hectare.

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**Package of Practices (PoP) of Barnyard Millet**

**Crop-** Barnyard Millet

**Botanical name-** *Echinochloa frumentacea*



**Climate:** Warm and moderately humid climate is good for rising Barnyard millet crop. It is a hardy crop and is able to withstand adverse conditions of weather better than cereals.

**Soil:** It thrives best on the sandy loam soil having sufficient amount of organic matter. Gravely and stony soil soils with poor fertility are not suitable for raising Barnyard millet.

**Sowing time:** In Tamil Nadu, rainfed crop is sown in September-October and irrigated crop in February-March. In Uttarakhand and north-eastern states, sowing in April-May is ideal.

**Varieties:** A number of varieties with high yield potential have been released for different states.

**Seed rate and spacing:** Optimum spacing of 25 cm between rows and 10 cm between plants within row and seed rate of 8-10 kg/ha for line sowing and 12-15 kg/ha for broadcasting are optimum.

**Manuring and fertilization:** Apply 5 tonnes of farm yard manure per hectare 2-3 weeks before sowing and fertilizer required for different states is different. For Andhra Pradesh, NPK ratio is 20:20:0; for Bihar, Tamilnadu and UP, NPK ratio is 40:20:0.

**Irrigation management:** Generally barnyard millet does not require any irrigation. However, if dry spell prevails for a longer period, then one irrigation at 25-30 DAS (Day after sowing) and second irrigation at panicle initiation stage 45-50 DAS.

**Weed Control:** Post-emergence application of 2, 4-D sodium salt (80%) @ 1.0 kg a.i./ha at 20-25 DAS. Isoproturon @ 1.0 kg a.i. /ha as pre-emergence spray is also effective in weeds control.

**Diseases and insect-pest management:** **Downy mildew** disease can be controlled by spraying of 0.2% solution of Mancozeb 75 WP in standing. Rust is controlled by spraying of Mancozeb 75 WP at the rate of 2 kg in 1000 litres of water per hectare may check the spread of this disease. For control of **Stem borer**, apply Phorate @15 kg/ha (10% granules) in the soil at the time of field preparation.

**Harvesting:** The crop should be harvested when it is ripe. It is cut from the ground level with the help of sickles and stacked in the field for about a week before threshing is done by trampling under the feet of bullocks.

**Yield:** Grain-12-15 qtl/ha and Straw-20-25 qtl/ha.

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**Package of Practices (PoP) of Little Millet**

**Crop- Little Millet**

**Botanical name-** *Panicum sumatrense*



**Climate:** Little millet originated in south-east Asia and is now a days it is grown throughout India, particularly in Madhya Pradesh Orissa Jharkhand and Uttar Pradesh. It can withstand both drought and water logging.

**Soil:** Little millet can be grown on a wide adoptability to different soil from very poor to very fertile. The best soil is alluvial, loamy and sandy soil with good drainage.

**Varieties:** A number of varieties with high yield potential have been released for different states.

**Season:** Sowing is done in middle of June in Orissa. In Tamil Nadu, south-west monsoon crop is sown in June and north-east monsoon crop in September-October. For Karnataka, Madhya Pradesh and South Bihar sowing during the last week of June to first week of July is desirable to escape damage from shoot-fly and gall-midge.

**Seed rate and spacing:** The optimum spacing is 22.5 cm between plants within a row. Shallow sowing at a depth of 2-3 cm is optimum for quick establishment of crop. The seed rate of 8 kg/ha for line sowing and 12 kg/ha for broadcasting is optimum.

**Manuring and fertilization:** 5 tonnes of farm yard manure per hectare 2-3 weeks before sowing. The fertilizer (NPK) required 20:20:0 kg /ha for Andhra Pradesh, Bihar and Odisha. 40:20:0 kg NPK /ha is required for Tamil Nadu.

**Irrigation management:** First irrigation at 25-30 DAS and second irrigation at 45-50 (DAS).

**Weed Control:** Two inter-cultivation and one hand weeding in line sown crop and two hand weeding in broad cast crop are necessary for effective weed control. Post-emergence application of 2, 4-D sodium salt (80%) @ 1.0 kg a.i./ha at 20-25 DAS. Isoproturon @ 1.0 kg a.i./ha as pre-emergence spray is also effective in weeds control.

**Diseases and insect-pest management:** **Downy mildew** disease can be controlled by spraying of 0.2% solution of Mancozeb 75 WP. Smut disease can be controlled by seed treatment with thiram or ceresan @ 2.5 g/kg of seed and soaking seeds in hot water at 55 °C for 7-12 minutes. For control of **Stem borer**, apply Phorate @15 kg/ha (10% granules) in the soil at the time of field preparation.

**Harvesting and Yield:** *Kharif* season crop-September to October and *Rabi*-January to February. With improved package of practices one can obtain 12-15 qtl/ha of grain yield and 20-25 qtl/ha of straw yield. For proper storage moisture in grain should not be more than 10-12 %.

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