

Package of Machinery



Sorghum

Production and Post Production Management



ICAR-Central Institute of Agricultural Engineering

Nabi Bagh, Berasia Road, Bhopal-462 038 (M.P.) India

Technical bulletin
on
Package of Machinery for Production and Post
Production Management of Sorghum Crop

Under
the project
**“Expansion of Activities of Biotech Kisan Hub in Eight
Aspirational Districts in Madhya Pradesh-Phase II”**

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Package of Machinery for production and post production management of Sorghum Crop

Introduction

Sorghum is one of the most important millet crops of India, cultivated in about 8 million hectares annually. Sorghum provides highly nutritious food, feed and fodder and has great potential for industrial use as bio-ethanol for fuel. As principal crop of dry land, it is popular with farmers due to assured grains and fodder yields for low-input cultivation, under harsh weather, especially in drought. Sorghum is high in carbohydrates and one of the staple crops for millions of semi-arid residents. It is known As the King of Millets and also the camel crop. Its main ingredient is starch, which is digested more slowly than in other cereals and also has a low protein and fat digestibility. Sorghum is most important rain fed crop of Madhya Pradesh & cultivated by 80 to 90 % marginal farmers. Due to erratic behavior of rainfall, the area under sorghum cultivation will increase gradually in MP. At Present about 47% area under sorghum cultivation is in the major tribal districts of M.P. (of total 1.12lakh ha) and its average productivity is 30% less than national average.

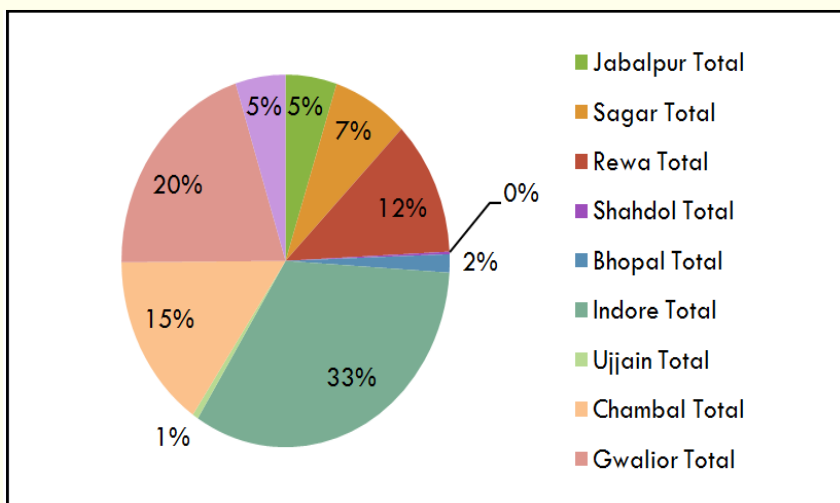



Fig. 1: Division wise sorghum cultivation area of the Madhya Pradesh state

About Sorghum

Crop name	Sorghum	
Scientific name	<i>Sorghum bicolor</i> (Gramineae family)	
Cropping season	Kharif (June to October)	
	Rabi (November to February)	
Purposes	Grain, Fodder	
Major growing states	Maharashtra, Andhra Pradesh, Karnataka, Madhya Pradesh, Gujarat, Tamil Nadu, Rajasthan, Punjab and Uttar Pradesh.	
Major growing districts of Madhya Pradesh	Chhindwara, Chhatarpur, Singrauli, Sidhi, Badwani, Burhanpur, Betul.	
Climate		
Temperature	Sowing	25-30°C
	Harvesting	18-16°C
Water requirement	400-700 mm	
Popular varieties	SL44, Punjab Sudax, SSG 59-3, Pusa Chari, HC 136, Pusa Chari 9, Pusa Chari 23, MP Chari, HC 260, HC 171, Harasona 855 F, CSH32, CSH 35, MFSH 3.	
Varieties suitable for M.P.	CSH 28, CSH 29, CSH 30, CSV 24SS, CSV 27, CSV 30F, Raj Vijay Jowar 1862 (RVJ 1862), CSV 34, CSV 15, CSV 17, JJ 741, JJ 938.	
Plant protection	Major Insect Pest - Shoot fly, Stem borer, Grain mold, Downey mildew, Ear head caterpillar, Ear Head bug, Sorghum Midge.	
	Major Disease - Anthracnose, Rust, Ergot, Head mould/Grain mould/Head blight, Downy mildew, Leaf Blight, Grain smut/Kernel smut / Covered smut / Short smut.	

Production in India	4.25 million MT (2021-22)				
Nutritional Benefits (100g grain)	Protein(g)	Fibre (g)	Minerals(g)	Iron (mg)	Calcium (mg)
	10	4	1.6	2.6	54
Sorghumin M.P. state	Parameter	Productivity (Kg/ha)	Area (ha)	Production (MT)	
	Total	3617	112320	217962	

Health benefits of sorghum

- Sorghum is rich in fiber and Gluten Free.
- Sorghum is a great source of protein and food for diabetics.
- Sorghum is rich in Essential Minerals and promotes the health of our Bones.
- It preserves the health of our Digestive system and also great source of proteins for Vegetarians and Vegans.
- It is rich in antioxidants and more sustainable than other Grains.
- It has high content of dietary fibers and also natural cure for patients of diabetes, staple food for celiac patients, lowers blood cholesterol etc.

Mechanization of sorghum crop

Agricultural mechanization implies the use of various power sources and improved farm tools and equipment, with a view to reduce the drudgery of the human beings and draught animals, enhance the cropping intensity, precision in metering and placement of various crop inputs (seed, chemical, fertilizer, irrigation, water etc.) and reduce the losses at different stages of crop production. The end objective of farm mechanization is to enhance the overall productivity and production with the lowest cost of production. Use of commercially available and under development machinery by various research institute on sorghum may be able to form a package of machinery for various operation involved in the sorghum production. Variety of commercially available machinery for seed bed preparation, seeding, intercultural, plant protection, harvesting and threshing machinery are available. The package of machinery may vary from the power source available such as manual, bullock/animal operated, tractor/power operated as per the diverse scenario in Madhya Pradesh and at country level. Operation wise machinery and its application is summarized in below sections.

Operation wise machinery for sorghum crop


Seed bed preparation machinery

Tillage, in particular primary tillage, is the foundation of any crop production system and is the most expensive practice in the production any crop. It helps to create favorable environment to grow the plants. There are various types of tools and implements available to perform the tillage or seed bed preparation.



Reversible Mould board (MB) plough

This implement is used to turn soil up to 300 mm deep and is particularly effective on heavier soils. Turning the soil also has the advantage that weed, seeds and unwanted crop residue can be buried deeply. MB ploughs are not recommended on sandy soils, because poor structure units which may exist can be

	<p>destroyed, promoting wind erosion. Single bottom, two bottom, three bottom and five bottom ploughs are available in the market, right now reversible MB plough mostly used.</p> <p>Field capacity: 0.11-0.15 ha/h</p> <p>Cost, Rs.: 35000-50000/-</p> <p>Tractor suitable: 35-55 hp</p>
	<p>Disc plough</p> <p>The disc plough has a slicing action with the main advantage that better penetration is obtained under dry, hard conditions, with an additional advantage that wears is lower than moldboard plough. The implement is useful on hard, dry soils.</p> <p>Field capacity: 0.12-0.16 ha/h</p> <p>Cost, Rs.: 60000-90000/-</p> <p>Tractor suitable: 35-55 hp</p>
	<p>Chisel plough</p> <p>Chisel plough is used mainly to loosen the soil to a limited depth of 250 mm. The best results are obtained if the soil is relatively dry, because the chisels break the soil, creating structural units. If conditions are too dry, however, big clods are formed, which restrict plant development.</p> <p>Field capacity: 0.13-0.15 ha/h</p> <p>Cost, Rs.: 20000-30000/-</p> <p>Tractor suitable: 35-55 hp</p>
	<p>Rotavator</p> <p>Rotavator or rotary tiller is a versatile tractor implement to perform different soil functions such as mixing, pulverization, puddling & leveling at the same time. Under ideal conditions, on moist clay soils, this useful implement can prepare the seedbed in one operation.</p> <p>Field capacity:0.2-0.21 ha/h</p> <p>Cost, Rs.: 80000-100000/-</p>

Weight:400-600kg
Tractor suitable: 45-55 hp



Cultivator

Cultivator is an important agricultural implement used both as a primary tillage and secondary tillage. It is widely preferred by farmers for use in gardening, landscaping, and other farming operations. Spring loaded tines cultivator, Rigid tyne cultivator, Duck foot cultivator are the types of cultivator generally used in India. Tine cultivators include a variety of hoeing implements, which are mainly used for controlling young weeds, but also for breaking surface crusts. These implements are only effective on moist soils. They are completely ineffective on dry, clay soils.

Field capacity: 0.2-0.4 ha/h
Cost, Rs.: 40000-50000/-
Tractor suitable: 45-50 hp



Harrows

A tractor harrow is used in agriculture to break up and smooth out the soil. In this way, it differs from the plough as plough used for deeper tillage. Farmers use tractor harrow on fields to smooth out the rough finish left by ploughing operations. The harrow implement breaks up clods and provides a more delicate finish, good tilth, or soil structure suitable for seedbed use. Harrows include a variety of implement. The tine harrow and disc harrow is primarily used to level the seedbed once it is in a fine condition.

Field capacity:0.18-0.22 ha/h
Cost, Rs.: 90000-100000/-
Tractor suitable: 35-55hp



Laser Land Leveler

It consists of a laser transmitter, a laser receiver, an electrical control panel, a twin solenoid hydraulic control valve, two wheels and a leveling bucket. The laser transmitter transmits a laser beam, which is intercepted by the laser receiver mounted on the leveling bucket. The control panel mounted on the tractor interprets the signal from the receiver and opens or closes the hydraulic control valve, which raises or lowers the bucket. Some laser transmitters have the ability to operate over graded slopes ranging from 0.01% to 15% and apply dual controlled slope in the field.

Tractor suitable: 55 hp or above

Cost, Rs.: 3,50,000/-

Sowing/planting Machinery

The basic objective of sowing operation is to put the seed and fertilizer in rows at desired depth and seed to seed spacing, cover the seeds with soil and provide proper compaction over the seed. The recommended row to row spacing, seed rate, seed to seeds placing and depth of seed placement vary from crop to crop and for different agro-climatic conditions to achieve optimum yields. Traditional sowing methods have following limitations; such as non-uniform distribution of seeds, poor control over depth of seed placement, high seed rate required, thinning required to maintain plant population, poor plant stand, weeding is a problem, lower yields etc. Therefore, use of seed drills and planters could be good option which facilitates line sowing and easy intercultural operations and well as mechanized intercultural as well as harvesting operations. The main function of seed drill and planters is to meter seeds of different sizes and shapes and place the seed in the acceptable pattern of distribution in the field. Place the seed accurately and uniformly at the desired depth and cover the seed and compact the soil around it to enhance germination. Few machineries with their functions and performance are given below.



ICAR-CIAE Manually Operated Single Row Seed Cum Fertilizer Drill

This Manual seed cum fertilizer drill is used for sowing of different seeds viz., wheat, sorghum, groundnut, cotton, castor, garlic, maize, cumin, soya bean, sunflower, paddy (dry land), all types of grains, cereals & pulses along with fertilizer. It is easily operated in both mode (Push and Pull type). The depth of sowing is also adjusted from 50.8-76.2mm.

Dimension: 1765mm x 613mm x 597mm

Weight: 22 kg

Cost, Rs.: 7,100/-

Field efficiency:65-70%



Manually operated multi millet seed cum fertilizer drill (Inclined plate type)

It is a manually operated light weight three row planter suitable for planting of small seeds such as millet crops, sorghum, bajra and vegetables seed etc. It saves the cost of seeds to the tune of 90% as compare to traditional method of broadcasting.

Output capacity: 0.10 ha/h

Field efficiency: 65-68%

Cost, Rs.: 12000/-



Manually operated multi millet seed cum fertilizer drill (vertical plate type)

This implement is available with vertical plate type metering system. Planting with this machine saves seed, fertilizer and cost compared to drilling by traditional methods. It saves the seeds to the tune of 90% as compare to traditional method of broadcasting.

Output capacity:0.10 ha/h

Field efficiency:65-68%

Cost, Rs.: 11000/-



Animal drawn inclined plate type seed-cum-fertilizer planter

It is an animal drawn implement suitable for planting sorghum, maize, and groundnut by changing suitable type of metering plates. Cell type rotors are used for metering the fertilizer and inclined plate is used for seed and which are driven by a chain and sprocket mechanism driven by the ground, wheel. It saves 86% labour, 58% operating time and 52-68% on cost of operation compared to conventional method Increases 20% in yield.

Output capacity:0.12 ha/h

Field efficiency:65-70%

Cost, Rs.: 17500/-



Animal drawn vertical plate type seed-cum-fertilizer planter

This implement is a light weight unit with low ground clearance and suitable for planting of multi-crops such as millets, jute, carrot, grams etc and drills fertilizer simultaneously. There is a saving of 60-70% towards input and operational cost compared to traditional methods.

Output capacity:0.12 ha/h

Field efficiency:65-70%

Cost, Rs.: 15000/-



Two Row Seed Cum Fertilizer Drill

Suitable for sowing crops like wheat, gram, sorghum, lentil, pea. Sunflower etc. and drilling fertilizer in black soil under rainfed conditions for small bullocks.

Field capacity: 0.05-0.08 ha/h

Power Source: A pair Of Bullocks

Cost, Rs.:7000/-



Power Tiller Seed cum Fertilizer Drill

Suitable for sowing seeds of wheat soybean, bengal gram, sorghum etc, in medium and heavy soil.

Field capacity : 0.20-0.25 ha/h

Power Source: Power Tiller (8-10 hp)

Cost Rs.: 18000/-



Tractor Drawn Six-Row Planter with Fertilizer Drill for Millet- Multi- Crops (Inclined Plate Type)

It is a light weight six row planter with fertilizer drill and available inclined plate seed metering system suitable for small and multi-crops seeds. There is a saving of 60-70% towards input and operation cost while using this equipment compared to traditional methods. Tractor suitable for operation 45 kW and above

Output capacity: 0.52 ha/h

Field efficiency: 80-85%

Cost Rs. : 38000/-





Tractor Drawn Six-Row Planter with Fertilizer Drill for Millet- Multi- Crops (Vertical Plate Type)

It is a light weight tractor operated six row planter with fertilizer drill and available in vertical plate type seed metering system. The implement has been developed with low ground clearance for effective sowing of millets and other multi crops. There is a saving of 60-70% towards input and operation cost while using this equipment compared to traditional methods.

Output capacity: 0.42 ha/h

Field efficiency: 80-82%

Cost, Rs.: 32000/-

	<p>Tractor drawn seed cum fertilizer drill</p> <p>It's a tractor drawn drill consists of frame, seed box, fertilizer box, seed metering mechanism, fertilizer metering mechanism, seed tubes, furrow openers, seed adjusting lever and transport cum power transmitting wheel.</p> <p>Field Capacity: 0.2-0.25ha/h</p> <p>Cost, Rs.: 40000/-</p>
	<p>ICAR- CIAE Tractor drawn 9- row drum type pneumatic planter</p> <p>It can be used for planting various type of crops like cotton, groundnut, pigeon pea, soybean, green gram, black gram, maize etc.</p> <p>Multi seeds (hill dropping) can be planted at specific distance.</p> <p>Field capacity: 0.3-0.7 ha/h</p> <p>Power Source: 35 hp or above</p> <p>Cost, Rs: 1-1.5 lakh</p>

Intercultural and weeding machinery

Weeds consume nutrients and harbor destructive insects. Management of weeds is an important component of production systems as elimination of weeds is expensive and hard to achieve. Weeding is the process of eliminating competition of unwanted plants to the regular crops so that crops can be grown profitably. Weeding is expensive and drudgeries these operations are accomplished by means of many tools and equipment, such as hoes, cultivators, harrows, rotary hoes etc. Weeding and intercultural equipment can be classified as manual, animal drawn, power tiller operated and tractor drawn. Few available tools and machinery with their performance parameters are given below.



Manual weeder

Manual weeder is a multi-attachment tool used for many operations like tilling of soil, making furrows and weeding. It has a lightweight tyre for easy operations. All these attachments can be easily attached and removed. The wheel hoe is a widely accepted weeding tool for weeding and intercultural in row crops.

Weight: 8kg

Cost, Rs.:3550/-

Field capacity: 0.01 ha/h



Self-propelled Rotary Weeder

A self-propelled engine operated power weeder is used for intercultural operation in horticulture and wider row crops like sorghum, maize etc. The depth of operation ranges from 40-70mm. The machine can be operated at an average forward speed of 1.5 to 2.0 km/h and crop having average row width of 450mm.

Field Capacity:0.6 to 1.0 ha/day

Field Efficiency:80-94 %

Power:5-7hp



Power Operated Sweep Cultivator

Suitable to perform interculture operation in soybean, sorghum, Bengal gram, pigeon pea and other wider spaced crops in medium and heavy soils.

Field Capacity : 0.18-0.25 ha/h

Power Source: Power Tiller (8-10 hp)

Cost Rs. : 8000/-

Plant protection machinery

Chemical application is an important aspect of the modern agriculture to save crop from insects, fungus, virus and other pest, as well as weeds. Weeds can be eradicated by effective cultivation, but pests and diseases have to be kept under control with chemical spray and powder application. Chemicals are now being used to kill weeds without damaging the crop in addition to the weeding tools. Chemicals are either sprayed in liquid form or applied as a dry powder. Sprayers and dusters are available for this purpose. Few useful machineries with their functions and performance are given below.



Manually Operated Knapsack sprayer

Knapsack sprayer consists of a pump and an air chamber installed in a 9 to 22.5 liters' tank. The handle of the pump extending over the shoulder or under the arm of operator makes it possible to pump with one hand and spray with the other. It has a spray lance fitted with nozzle and has two straps for mounting the sprayer at the back of the operator.

Power required-one man

Cost, Rs.:2500-4000/-

Field capacity:0.5-1ha/day



Power Knapsack Sprayer

It consists of a frame on which a high density polyethylene tank, fuel tank, engine, delivery pipe, shock proof cushion and spray hose are mounted. This product is supplied with forced air cooled 4 Stroke petrol Engine. It is equipped with a brass metal pump and has the diaphragm of type carburetor. It is powerful and can maintain stable pressure. It adopts double cylinder pump, which enhances the operational efficiency.

Field capacity:1.5ha/day

Cost, Rs.:10000-12000/-



Tractor operated Boom Sprayer

The sprayers essentially consist of a tank which is made of fiber glass or plastic, pump assembly, suction pipe with strainer, pressure gauge, pressure regulators, air chamber, delivery pipe, spray boom fitted with nozzles. These are hydraulic energy sprayers. They utilize PTO power of the tractor to operate the pump of the sprayer.

Field capacity: 8 ha/day

Power requirement: 35 hp or above

Cost, Rs. :50000/-

Harvesting machinery

Harvesting is the process of collecting the mature crop from the field. It consists of the action of cutting, picking, plucking, digging, or a combination of all these operations for removing the crop from under the ground or above the ground or detaching the useful parts such as, fruits, flowers or leaves from plants. In India, harvesting is traditionally done by hand, using sickle. Because of limited size of land holdings, economic constraints and non-uniformity of field conditions, traditional harvesting is still in practice. Due to high labor demand at the time of harvesting, the operation continues for weeks together, resulting in over drying of crops in the field causing grain losses up to 5 - 15 per cent and may also results in total loss of crop due to untimely rains during harvesting. Some useful harvesting techniques for sorghum are given below.



Improved serrated sickle

This Improved serrated sickle represents an advancement in manual crop harvesting. It is a handheld cutting tool designed for harvesting crops such as cereals, grasses, and other vegetation. The term "serrated" indicates that the sickle blade is equipped with small, jagged teeth or edges. This feature enhances the efficiency of cutting specific types of plants, thereby reducing the effort required during operation.

Field capacity: 0.018 ha/h

Weight: 0.2 kg

Cost, Rs.:120/-



Vertical Conveyor Reaper

It is an engine operated, walk behind type harvester suitable for harvesting and windrowing cereals and oilseed crops. The reaper consists of engine, power transmission box, pneumatic wheels, cutter bar, crop row dividers, conveyor belts with lugs, star wheels, operating controls and a sturdy frame. The engine power is transmitted to cutter bar and conveyor belts through belt pulleys. During forward motion of the reaper, crop row dividers divide the crop, which come in contact with cutter bar, where shearing of crop stems takes place. The cut crop is conveyed to one side of the machine by the conveyor belt fitted with lugs and is windrowed in the field. The crop is bundled manually and transported to threshing yard. There are no shattering losses due to vertical conveying of the crop.

Power:5-7 hp

Length of Cutter bar:1000 mm

Cost, Rs: 80,000 - 150000/-



Combine Harvester

A multipurpose machine such as a combine harvester reduces the number of people employed in harvesting; thereby reducing manpower, time and effort taken which consequently increases the overall productivity. The Indian farmers produce a large variety of crops such as wheat, rice, soybean, corns and more. It is used for direct harvesting and threshing of crop. It can be used for harvesting other cereal crops in one operation by changing the header.

Cost Rs.: 20-25 lakh

Power requirement: 75-110 hp

Row spacing (mm): 460-685



Tractor front mounted hydraulic operated three-row sorghum harvester

It can do the harvesting of sorghum which is manually very tedious and time consuming. It is front mounted and hydraulically operated so can easily be carried to the field. It can cut the plant and earhead at a time windrow the cut plants in the field.

Output capacity:0.2 ha/h

Field efficiency:80-85%

Power source:55 hp or above

Cost, Rs.: 4,00,000/-

Threshing Machines

Threshing is the process of detaching the edible part of the plant from rest of plant. It is the step in grain preparation after harvesting and before winnowing, which separates the loosened chaff from the grain. Threshing may be done by manually beating the grain using a manual tool on a threshing floor. Another traditional method of threshing is to make bullocks or donkeys walk on the grain at threshing yard. Few threshers with their function and performance are given below.



Multi crop Thresher

This is mainly used for shelling wheat, sorghum, Mustard, soybean and other millets. Multi-crop Threshers consists of crop feeding chute, threshing cylinder having stud type beaters/ blades, blowers, set of sieves, sieve casing, flywheel, pulleys, grain and straw outlet etc. Different variants of threshers are self-feeding chute, double blower, double speed type.

Power:35hp or above

Cost: Rs 200000-250000/-

Weight:1530kg



CIAE High capacity Multicrop thresher

It consists of a spike-tooth cylinder (700mm diameter), three aspirator blowers, cleaning sieves and automatic feeding and bagging systems. The thresher is provided with accessories such as extra pulleys, concave, and sieves for threshing different crops. It is suitable for threshing wheat, maize, and sorghum grain, pigeon pea, soybean and sunflower crops.

Output Capacities: 1412, 2890, 1130, 1360, 950, 782, 553kg/h

Power Source: 20 hp electric motor or 35 hp tractor

Cost, Rs: 40,000-50,000/-

Processing and value addition machinery for sorghum

Value addition is the enhancement of the value of product before it is offered to the consumers. Value-added products are the agricultural products that are modified to enhance the market value and/or shelf life and enhanced quality. The value-added products include bread, cakes, sauces and other processed foods. Some prominent basic processing machinery described as following.



Manual Double screen cleaner


It is a batch type hand operated equipment to replace existing traditional practice i.e. manual horizontal / vertical sieving to clean the grains. It separates impurities like stubbles, chaff, dirt and broken from wheat, bengal gram, soybean and other cereals and pulses. It consists of main frame scalper/grading screen, draper rod, handle, shutter etc. and operated by hanging it on any elevated point with ropes.


Power source :	: Human Power
Weight, kg	: 17.6 kg
Cost, Rs.	: 4,500/- (approx.)
Labour requirement	: 5.0 man-h/t
Output capacity, kg/h	: 125-225
Cleaning Efficiency	: 99.0%



Pedal Operated Winnower-Cleaner-Grader for Millets

A winnower-cleaner-grader is suitable equipment for winnowing, cleaning and grading of millet, cereal and pulses crops in single pass. The major components of the machine are fabricated using fiber reinforced plastic material. It consists of a winnower, cleaning sieve and grading assembly

	<p>Power Source : Manual Weight, kg : 60 Man power : One Suitability for crop : Millets, wheat, paddy, lentil and soybean Cost, Rs : 8,000/- Output capacity, kg/h : 250 - 350 Efficiency : 96% Cost of operation, Rs/kg : 0.04/-</p>
	<p>ICAR CIAE-Millet Mill (Model-I) This is efficient in dehulling small millets viz., foxtail millet, little millet, kodo millet, proso millet, barnyard millet in a single machine. This machine has the advantage to produce high-quality kernels (with/without bran). It provides a simple, economical, and efficient method for dehulling all minor millets. It can be installed as an enterprise in the millet production catchment areas under rainfed conditions and in tribal areas.</p> <p>Power requirement : 0.75 kW, single phase motor Weight, kg : 112 (excluding motor) Mode of operation : Continuous type Working principle : Gentle abrasion/attrition & (aerodynamic) cyclone separator Floor area : 860 mm x 842 mm Capacity, kg/h : 100- 110</p>

	<p>Dehulling efficiency, % : > 70</p> <p>Feed moisture % wb : 10-12</p>
	<p>ICAR CIAE-Millet Mill (Model-II)</p> <p>CIAE Millet Mill Model-I is redesigned ergonomically. Comfortable height based on ergonomic data to suit the height of Pan-Indian rural women. It is efficient in dehulling all small millets foxtail millet, little millet, kodo millet, proso millet, barnyard millet with a single machine. Sweeping wings to clear the dehulled mass in dehulling chamber towards are attached the outlet chute. Flow deflector in there for better disposal of dehulled mass from the dehulling chamber by deflecting them towards outlet chute. Acrylic window to allow visual access into dehulling chamber.</p> <p>Power requirement : 0.75 kW, single phase motor</p> <p>Weight, kg : 150 (excluding motor)</p> <p>Mode of operation : Continuous type</p> <p>Working principle : Gentle abrasion/attrition & (aerodynamic) cyclone separator</p> <p>Floor area : 1120 mm x 900 mm</p> <p>Capacity, kg/h : 100</p> <p>Dehulling efficiency, % : >90</p> <p>Feed moisture % wb : 10-12</p>



Millet Flaking Machine

This is used to produce good quality flakes from millets, process technology and equipment has been developed. The millet flaking machine produces flakes from pre-treated whole sorghum grains. The machine operates using 0.5 hp single phase motor. The minimum flake thickness achievable by the machine is about 0.5 mm with flaking efficiency of about 92%. A process was developed for preparation of sorghum flakes by fermenting the grains with suitable cultures, steaming and then mechanically pressing into flakes. Fermentation was found to improve appearance and texture of flakes. The equipment can also produce flakes from pearl millets and other food grains of similar size.

Efficiency: 92%;

Power requirement: 0.5 hp



ICAR-CIAE millet popping machine (Model I)

This is suitable for popping of sorghum, amaranthus, finger millet, kodo millet, and other small grains including paddy, rice, and corn etc.

- Mode of operation: continuous
- Power requirement: 5 kW (Three phase)
- Capacity: 1.4-2 kg/h
- Popping efficiency: 60-70 % popping recovery for Sorghum & Amaranthus.
- The overall dimension: 1000 mm x 970 mm x 580 mm
- Total weight: 80 kg



Millet Processing Line

This processing line can produce fermented millets and millet flakes with a set of machine, such as ferment or cum steaming vessel, pneumatic conveyor cum dryer, flaking machine.

Fermentor cum steaming vessel

- Mode of operation: Batch type
- Capacity: 0.150 m³
- Working volume: 0.105 m³
- Power requirement: 1 hp (agitator) + mini boiler
- Temperature controller: PID controller
- Weight: 170 kg
- Suitable for sorghum, pearl millet, kodo millet, other and grains, liquid & pulps
- Capacity: 25 kg/day





Pneumatic Dryer cum Conveyor

A pneumatic dryer cum conveyor can be especially valuable in the processing of millets. Millets are highly nutritious grains that require careful handling during processing to maintain their quality. This equipment efficiently dries millets while simultaneously transporting them, ensuring that they reach their final destination in optimal condition. The pneumatic operation allows for precise control over the drying process, which is crucial for preserving the nutritional content of millets. It helps streamline the production process, making it more efficient and cost-effective for millet farmers and processors.

- Mode of operation: continuous
- Power requirement: 3 hp blower
- Capacity: 100 kg/h
- Suitable for sorghum, pearl millet, wheat

Products of sorghum

<p>Fermented Sorghum flour</p> 	<p>Ingredients: Whole grain sorghum</p>	<p>Salient features:</p> <ul style="list-style-type: none"> •Preservative free •Lower tannin •Better Taste •lower phytic acid •Better amino acid profile
<p>Masala Sorghum mix</p> 	<p>Ingredients:</p> <ul style="list-style-type: none"> •Fermented Sorghum flakes •Defatted Soybean flour •Dairy ingredients •Dried vegetables •Spices & condiments 	<p>Salient features:</p> <ul style="list-style-type: none"> •Gluten free •High fibre •Adequate shelf life (3 month) •Preservative free •Better taste •Better nutrition
<p>Sorghum Upma Mix</p> 	<p>Ingredients:</p> <ul style="list-style-type: none"> •Fermented sorghum grits •Pulses •Dried vegetables •Spices & condiments 	<p>Salient features:</p> <ul style="list-style-type: none"> •Lower tannin & phytic acid •Better taste •Adequate shelf life (3 months) •Preservative free
<p>Baked Multi -Grain Chips</p> 	<p>Ingredients:</p> <ul style="list-style-type: none"> •Corn •Wheat •Rice •Sorghum •Soybean •Green gram •Skim milk powder 	<p>Salient features:</p> <ul style="list-style-type: none"> •Rich in proteins, fibre, minerals, anti-oxidants, phenolics & flavonoids •Preservative free •Adequate shelf-life (3 months)
<p>Multi-Grain Biscuits</p>	<p>Ingredients:</p> <ul style="list-style-type: none"> •Cereals •sorghum/finger-millet 	<p>Salient features:</p> <ul style="list-style-type: none"> •Rich in proteins, fibre, minerals, anti-oxidants,


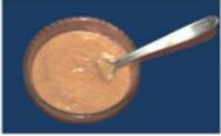
	<ul style="list-style-type: none"> •Pulses •Oilseeds •dairy ingredients •tropical fruits 	<ul style="list-style-type: none"> phenolics •Adequate shelf-life : 3 months •Preservative free •Ideal as any-time snack
<p style="text-align: center;">Multi-Nutrient Instant Porridge</p> 	<p>Ingredients:</p> <ul style="list-style-type: none"> •Sorghum •Finger-millet •Pulses •Oilseeds •Dairy ingredient •Protein isolates •Fruit 	<p>Salient features:</p> <ul style="list-style-type: none"> •High in dietary fibre •Good source of flavonoids, phenolics & antioxidants •4×protein & 2× more minerals than wheat porridge. •Preservative free

Table1: Machinery used by farmer and suggested machinery in aspirational districts of M.P.

Operation	Machinery used by farmer	Suggested Machinery
Tillage	Country plough, MB plough, Rotavator, cultivator	Reversible MB plough /Disc plough, Light weight rotary tiller/Disc Harrow
Sowing	Manual broadcasting, Seed drill, Bullock drawn Tifan	Tractor/ animal operated Seed cum fertilizer drill, Tractor Operated pneumatic planter
Plant protection	Knapsack sprayer (battery operated)	Power pump (engine operated), Tractor operated Boom sprayers
Intercultural	Manual khurpi or spade	Wheel hand hoe, Sweep cultivator, Self-propelled power weeder
Harvesting	Manually by use of sickle	Self-propelled fodder harvester (cutter bar type), Tractor mounted fodder harvester
Threshing	Traditional practices, - Conventional low capacity thresher	High capacity multi-crop thresher, CIAE multi-crop thresher

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