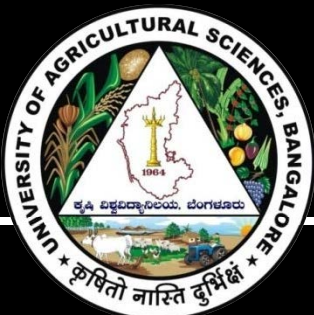


Machinery for Processing and Value Addition of Small Millets

Invited Talk
presented in
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(TNAU-DHAN)
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Dr V. Palanimuthu
Research Engineer & University Head
AICRP (PHET), GKVK
University of Agricultural Sciences
Bangalore - 560065

Millets Classification

Major millets

- Sorghum (jowar)
- Pearl millet (bajra)

Small (minor) millets

- Finger millet (ragi) (*Eleusine coracana*),
- Foxtail millet (*Setaria italica*)
- Little millet (*Panicum miliare* Lamk.)
- Proso millet (*Panicum milliaceam*)
- Barnyard millet (*Echichola frumentacra* Link)
- Kodo millet (*Paspalum scobiculatum*)
- Brown-Top Millet (

Small Millets

Ragi



Barnyard



Foxtail



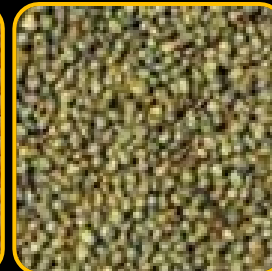
Proso



Little



Kodo



Popular Varieties

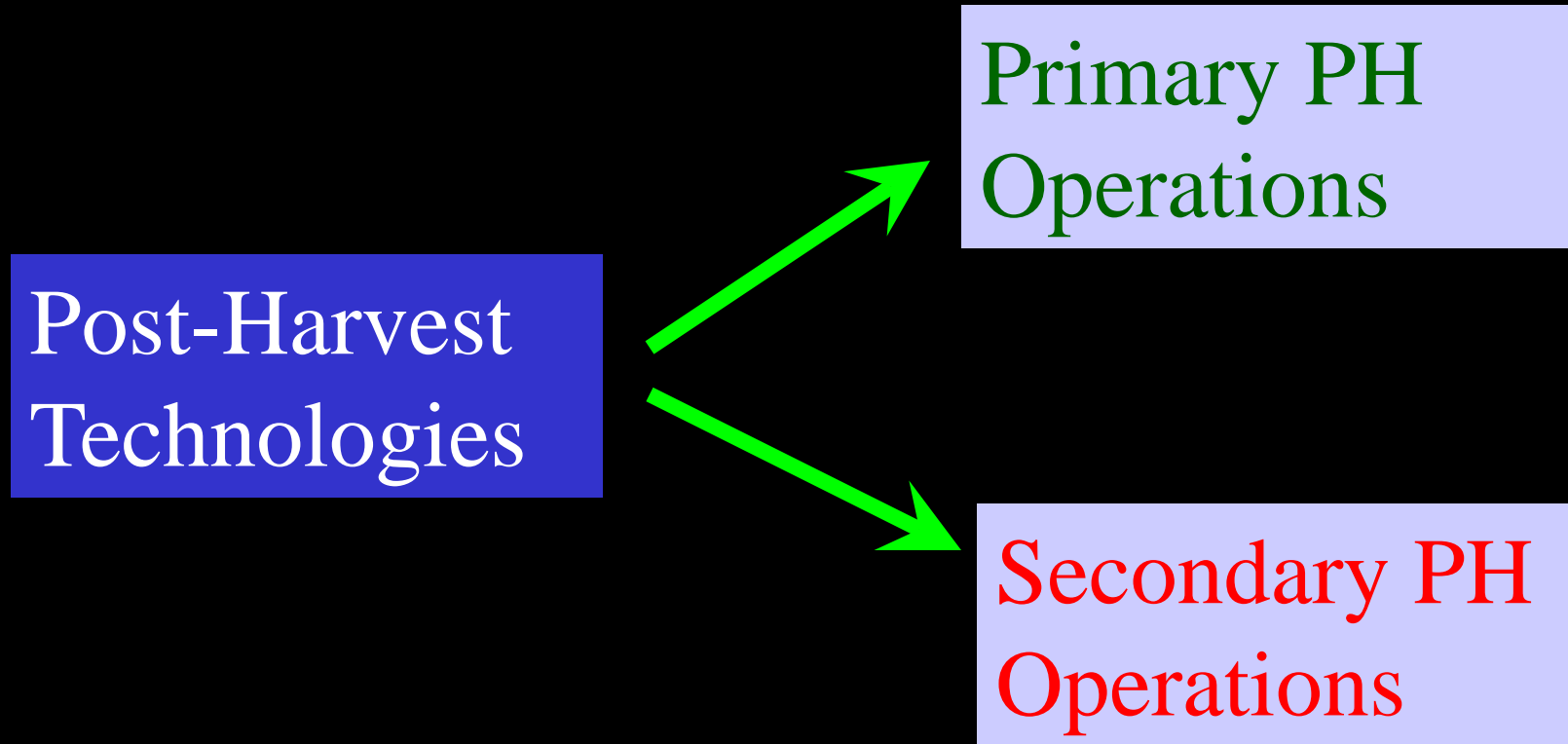
Ragi : Indaf Series , GPU 28, GPU 26, MR 1, MR 911, etc, all from UAS(B)

Other millets : Information can be obtained from **Project Coordinator (Millets), GKV, UAS(B)**

Introduction

- ❖ Total area under **millet**s 23-24 million hectares (Mha), **small millets** are cultivated in about 3.5 Mha which include 2 Mha under ragi and 1.5 Mha under other small millets (little, foxtail, kodo, proso and banyard millets)
- ❖ Small millets are grown in different states of India; Total **production - 1.78 Mt**; Indian Govt. has initiated huge project **“INSIMP”** to increase the area
- ❖ **Centre of Excellence on Millets** created @ UAS(B) with funding from Gol to promote processing & value addition
- ❖ Small millets are considered as **nutri-cereals** because of their **low glycemic index, high fibre content**, etc
- ❖ Many health benefits if consumed – **lesser incidence of cardio-vascular disease, duodenal ulcer, diabetic friendly**
- ❖ Consumed by rural and tribal people as traditional foods

Post-Harvest Processing of Millets



Primary Post-Harvest Operations

Unit operations carried out on the grains at producers' level or in the vicinity of farm which improves grain quality / transforms the grain into more useful form

Cleaning

Sorting

Grading

Drying

Dehulling

Polishing / Pearling

Size reduction /Grinding

Storage

Secondary Post-Harvest Operations

Unit operations that are carried out on grains either directly or after primary processing, that transform the grain into products generally for direct consumption.

They are done usually away from farm either in unorganized or in organized sectors.

Puffing
Milling

Baking
Flaking

Importance of Primary Processing

Cost of ragi at village level	=	Rs. 1100/qtl
Cleaning/pearling loss	=	5 kg
Cleaned ragi	=	95 kg
Cost of pearling	=	Rs. 25/qtl
Transportation & handling	=	Rs. 50/qtl.
Total Cost / Qtl.	=	Rs. 1175
Revenue	=	$95 \times 15 = \text{Rs. } 1425$
Profit by primary processing	=	$1425 - 1175 = \text{Rs. } 250$
In terms of investment	=	$250 / 1175 \times 100 = 21.28\%$
Profit from crop production	=	-ve (for ragi)

PRIMARY PROCESSING MACHINERY FOR MILLETS

Grain Pre-Cleaners



Destoner – Grain Cleaner



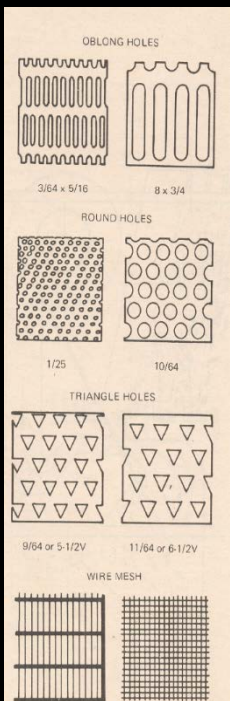
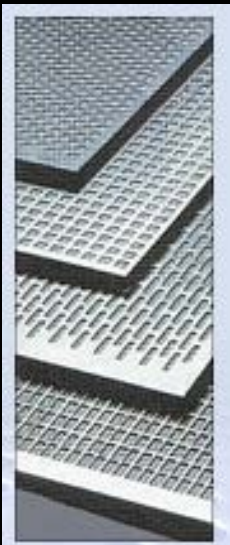
SCREENING

It is the method of separating grain / seed into two or more fractions according to the size alone using screens or sieves.

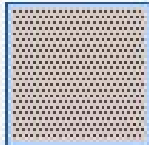
Factors Affecting Screening Operation

- Screen aperture size / shape / arrangement
- Effective opening area
- Screen motion
- Feeding arrangement
- Sieve arrangement
- Type of product
- Type of screen

SCREENS

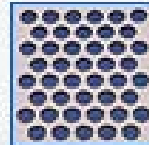


Microperforated



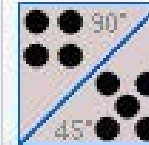
Low thickness sheets where holes diameter and thickness value are the same

Round holes 60°



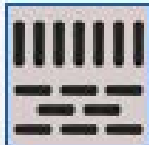
Round hole staggered 60° pattern from Ø of 0,3 mm on 0,3 mm thickness above

Rounds at 45° & 90°



Sheets with other perforations at 45° or 90° are also available on demand

Oblongs/slots



Perforated sheets with oblong holes, straight, staggered parallel long/short side

Square holes



Square holes sheets disposition straight, staggered, diagonal, etc.

Hexagonal holes



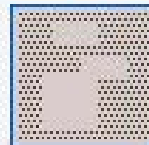
Hexagonal holes with high OA%, even at zones, small mid series and prototype

Flared & milled



Perforated sheets with flared holes, milled holes sheets, sheets for staircases

Zone perforations



Perforated sheets at zone, as drawing, in large and small series or even single

Special holes



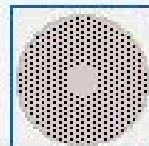
Pocket holes, triangle, octagon, rhomb, half moon, round slot, and many more

Sectors & seaves



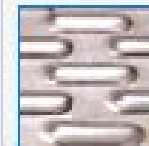
Sectors, seaves, trunks of cone as drawing, at measure even small quantity

Perforated disks



Perforated disks with decreasing perforation and borders also with blind center

Embossed sheets



Embossed sheets of round type, square, lozenge, rhomb and stick shape

INDIAN STANDARD SIEVES

Standards, and satisfy requirements of IS : 460 (Part-I) 1978 for the wire cloth test sieves and IS : 460 (part II) 1978 for perforated plate test sieves with respect to widths of aperture, permissible variations in aperture, wire diameter and screening areas.

The sieves from 22 micron to 3.35 mm size are available in 200 mm and have woven wire cloth fixed in spun brass frames, from 40 mm to 53 mm size are available in 300 mm size and from 63 mm to 125 mm size in 450 mm diameter.

The sieves of size 5.6 mm and above in 300 mm or 450 mm dia. are either of woven wire or perforated sheet and are fitted in G.I. Frames as per the requirement.

●● HS32.35

200 mm diameter, (Spun Brass Frame)

Aperture Size	Aperture Size
3.35 mm	850 µm
2.80 mm	710 µm
2.36 mm	600 µm
3.00 mm	500 µm
1.70 mm	425 µm
1.40 mm	355 µm
1.18 mm	300 µm
1.00 mm	250 µm
212 µm	63 µm
180 µm	53 µm
150 µm	45 µm
125 µm	38 µm
106 µm	32 µm
90 µm	26 µm
75 µm	22 µm



HS32.35

HS32.35.1 Lid and Receiver for 200 mm dia sieves, made of brass.

NOTE: All the aperture sizes listed under HS32.35 can be supplied in 100 mm or 150 mm dia spun brass frames on special order.

●● HS32.40

300 mm diameter, (Spun Brass Frames)

Aperture Size	Aperture Size
5.60 mm	300 µm
4.75 mm	250 µm
4.00 mm	212 µm
3.35 mm	180 µm
2.80 mm	150 µm
2.36 mm	125 µm
2.00 mm	106 µm
1.70 mm	90 µm
1.40 mm	75 µm
1.18 mm	63 µm
1.00 mm	53 µm
850 µm	45 µm
710 µm	38 µm
600 µm	32 µm
500 µm	26 µm
425 µm	22 µm

ACCESSORIES:

HS32.40 Lid and Receiver for 300 mm dia sieves, made of brass.

●● HS32.45

300 mm diameter (G.I. Sheet Frames)

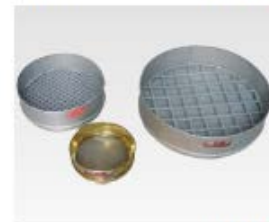
Aperture Size	Aperture Size
53 mm	16.0 mm
45 mm	13.2 mm
37.5 mm	11.2 mm
31.5 mm	9.5 mm
26.5 mm	8.0 mm
22.4 mm	6.7 mm
19.0 mm	5.6 mm
4.75 mm	4.0 mm

HS32.45.1 Lid and Receiver for 300 mm diameter sieves, made of G.I. Sheet.

●● HS32.50

450 mm diameter (G.I. Sheet Frames)

Aperture Size	Aperture Size
125 mm	22.4 mm
106 mm	19.0 mm
90.9 mm	16.0 mm
75.0 mm	13.2 mm
63.0 mm	11.2 mm
53.0 mm	9.5 mm
45.0 mm	8.0 mm
37.5 mm	6.7 mm
31.5 mm	5.6 mm
26.5 mm	4.75 mm



HS32.50

ACCESSORIES:

HS32.50.1 Lid and Receiver for 450 mm diameter sieves made of G.I. Sheet.

CONVERSION TABLE FOR STANDARD TESTSIEVES-

Indian Standard Sieve Designation	Sieve Series Width of Aperture mm	British Standard Sieve Series Mesh No.	ASTM. No.
5.60 mm	5.60	-	3.5
4.75 mm	4.75	4	4
4.00 mm	4.00	-	5
3.35 mm	3.35	5	6
2.80 mm	2.80	6	7
2.36 mm	2.36	7	8
2.00 mm	2.00	8	10
1.70 mm	1.70	10	12
1.40 mm	1.40	12	14
1.18 mm	1.18	14	16
1.00 mm	1.00	16	18
850 micron	0.850	18	20
710 micron	0.710	22	25
600 micron	0.600	25	30
500 micron	0.500	30	35
425 micron	0.425	36	40
355 micron	0.355	44	45
300 micron	0.300	52	50
250 micron	0.250	60	60
212 micron	0.212	72	70
180 micron	0.180	85	80
150 micron	0.150	100	100
125 micron	0.125	120	120
106 micron	0.106	150	140
90.9 micron	0.090	170	170
75.0 micron	0.075	200	200
63.0 micron	0.063	240	230
53.0 micron	0.053	300	270
45.0 micron	0.045	350	325

PRIMARY PROCESSING MACHINERY FOR MILLETS

Jowar Polisher



Ragi Pearler



Millet Rice Polisher



PRIMARY PROCESSING MACHINERY FOR MILLETS

Flour Mills

Stone Type (Mini)



Stone Type



Plate Type

Pulverizer, MS



Pulverizer, SS (Mini)



Pulverizer Double Cutting

Dehulling Machinery for Small Millets

Kodo Dehuller



**Foxtail / Little/
Proso Dehuller**



**Foxtail / Little/
Proso Dehuller**



All Millets



Victor Machines, Salem

Dehulling Machinery for Small Millets

Kodo Dehuller



**Foxtail / Little/
Proso Dehuller**



**Foxtail / Little/
Proso Dehuller**



All Millets



Victor Machines, Salem

Dehulling Machinery for Small Millets

**Multi Millet
Dehuller / Polisher**



**Kodo / Barnyard
Dehuller**



**Double Stage
Dehuller**



AVM Engineering Works, Salem

Dehulling Machinery for Small Millets

TNAU Multi Millet Double Stage Dehuller



ICAR-CIAE, Bhopal Multi Millet Dehuller



Bhavani Millet Dehuller, Mysuru



Borne Technologies, CBE



ICAR-CIPHET, Ludhiana Millet Mill



PROCESSING MACHINERY FOR MILLETS

Rubber Roll Sheller



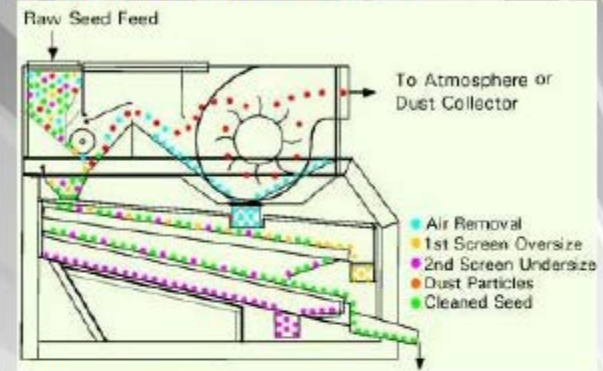
Rice Huller



Vertical Abrasion
Polisher

High Capacity Grain Cleaners

AIR SCREEN GRAIN CLEANER/ SEED CLEANER MODEL-PC-5



No. of Screen : 2
 Size of each screen : 122 x 180 cms (W x L)
 Screen Inclination : Variable
 Top :
 Middle & Bottom : Fixed

Screen Perforation Cleaning Device : Nylon Brush
 No. of Aspiration : One
 Fan Capacity : 3500 CFM at 75 mm WGSP
 Fan Speed : 1400 RPM
 Electric Motor Blower : 4 HP, 3 Phase, 380-440 V

Screen Cradle, Feed & Nylon Brush Drum : 1.5 HP, 3Phase, 380-440 V
 O.A. Size (LxWxH) : 225 x 180 x 235 cms

Suitable for cleaning of almost all types of cereals, Pulses, Spices, Oil Seeds, Vegetable Seeds, Coffee Beans etc

[LINK](#)

AGROSAW™

SPECIFIC GRAVITY SPERATORS

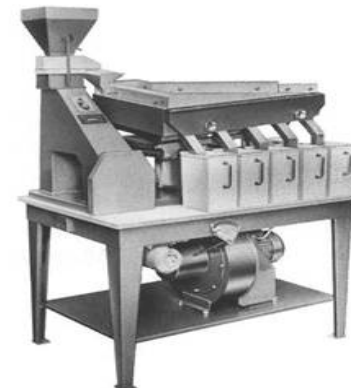


Application

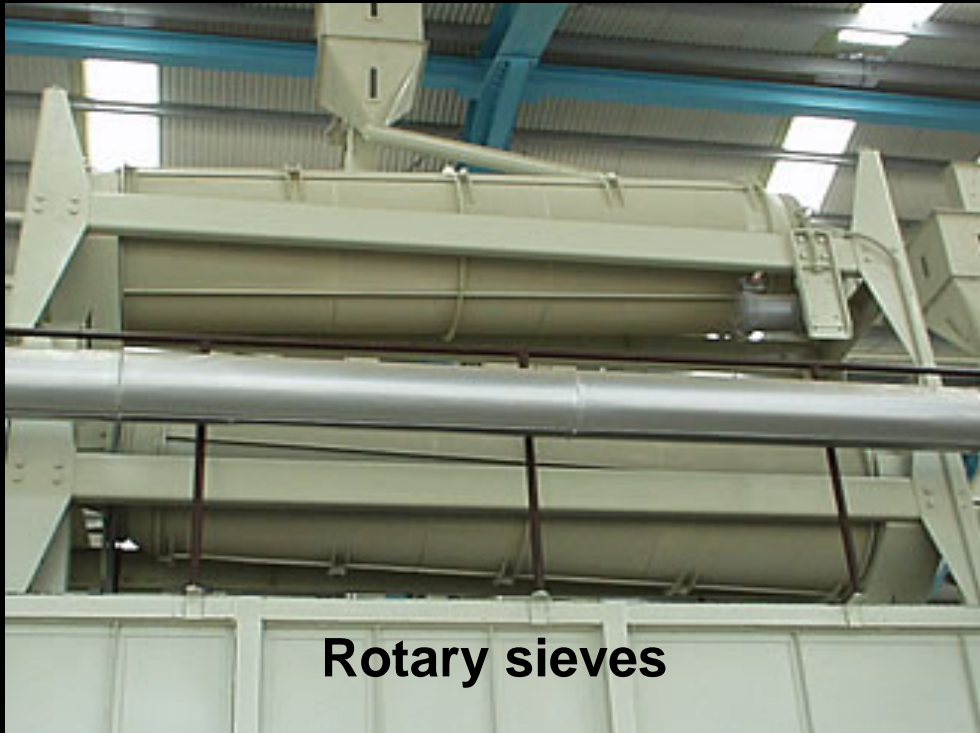
The Machine is specifically meant for removing impurities and achieving very high grading quality in any free flowing granular material, grains all types of seeds, spices, etc. It removes the impurities and upgrades the material on the principal of specific weight.

Technical Specifications			
	G-2	G-4	G-6
Cap. (based on Wheat)	1.5 to 2 TPH	3 to 4 TPH	5 to 6 TPH
No. of Fans	3	5	7
Size of Deck (mm) W x L	800 x 1500	1040 x 2340	1150 x 3100
Type of Deck	Rectangular Type	Rectangular Type	Rectangular Type
Electric Drive: Fan	4	7.5	10
HP : Deck	1.5	2	3

Specific Gravity Separator



Rotary Reel Separator



Vibratory Grader



Auxillary Systems for Cleaning / Grading

DUST ASPIRATION SYSTEM



 **AGROSAW** TM

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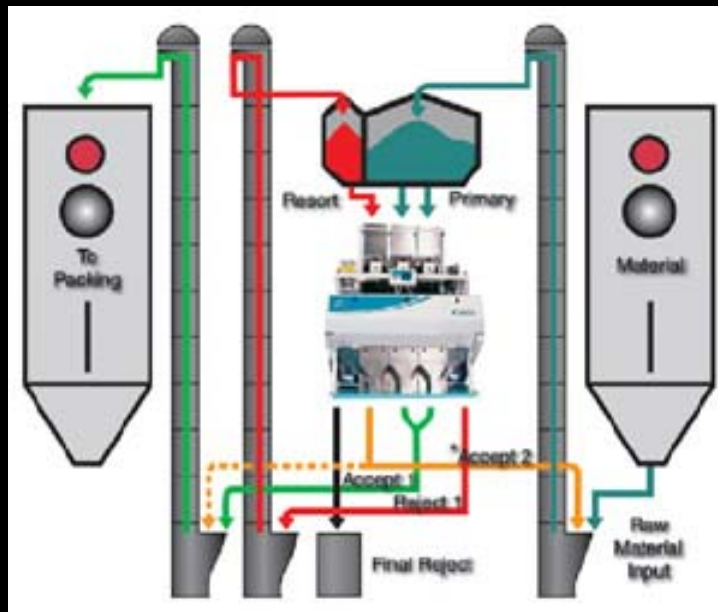
Flour Sifter



Plansifters



COLOUR SORTER



Millets Product Processing Machinery



Foxtail Kurkure



Twin Screw Extruder Machine



**Kurkure
+ Masala**

Millets Product Processing Machinery



Pasta Machine



Grain Roaster



Flaking Machine



Food Blender



FFS Packaging Machine



Millets Product Processing Machinery



Roti Machine



Biscuit Machine



Edge Runner



Grain Roaster



Thank You

Performance Evaluation of Different Dehusking Machines for Kodo Millet

- ❖ To evaluate four different machines namely, burr mill, rubber roll sheller, Victor millet mill model-I and Victor millet mill model- II for dehulling raw kodo millet
- ❖ To study milling characteristics of kodo millet at different moisture contents

Material & Methods

- ❖ Four machines used for dehusking –
 - Burr mill, Rubber roll sheller, Victor millet mill model-I and Victor millet mill model- II
- ❖ Kodo millet at three different initial moisture contents used – 9.0, 9.5 & 10.0 % (wb)
- ❖ Milling characteristics studied were:
 - Dehusking characteristics
 - Milling recovery
 - Head rice yield
 - Broken yield

Burr Mill



Rubber Roll Sheller



Victor millet mill : Model-I



Victor millet mill: Model-II



Milling Characteristics

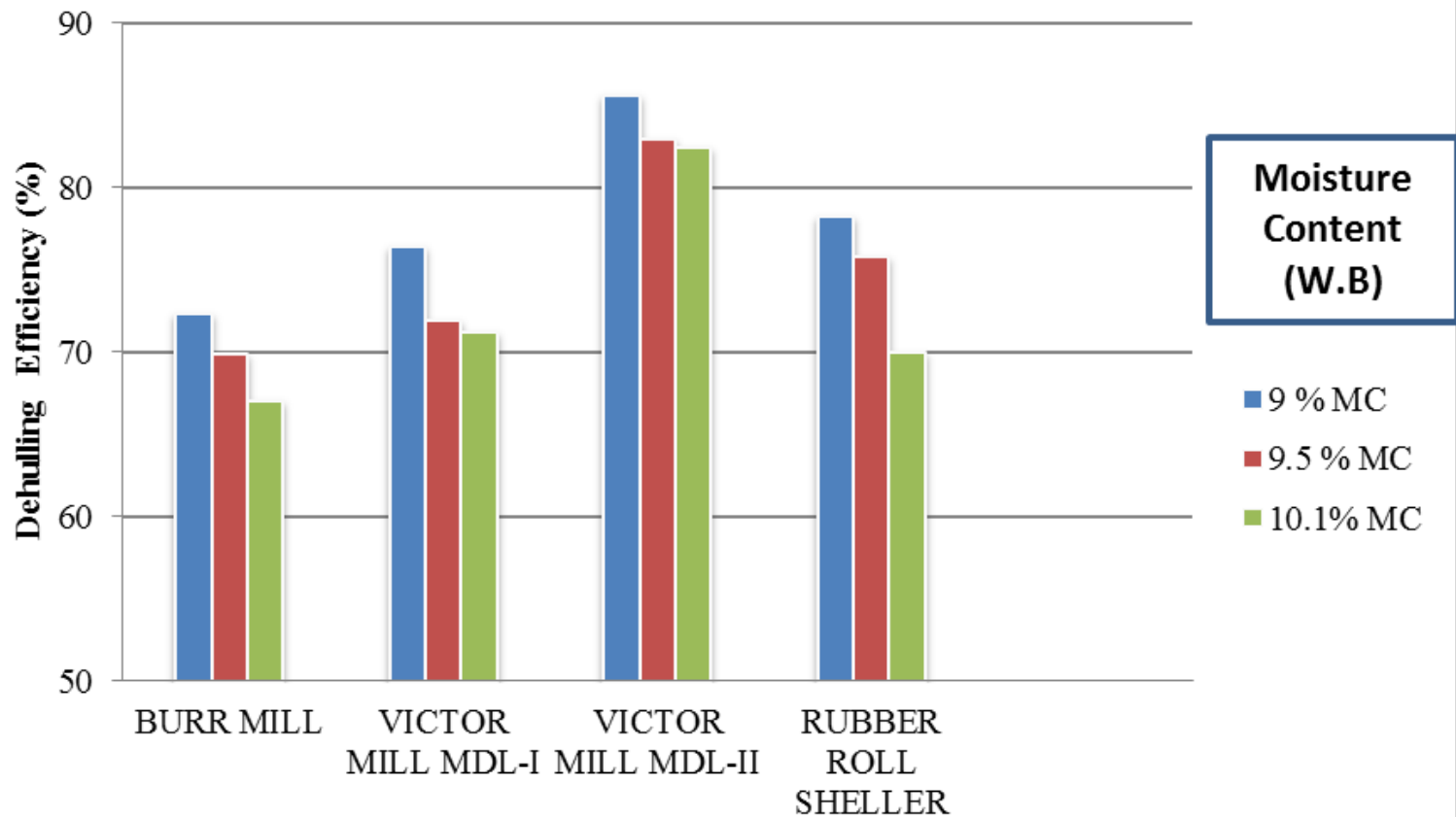


Fig. 1: Dehulling efficiency of four different millet mills for kodo millet at different moisture levels

Milling Characteristics

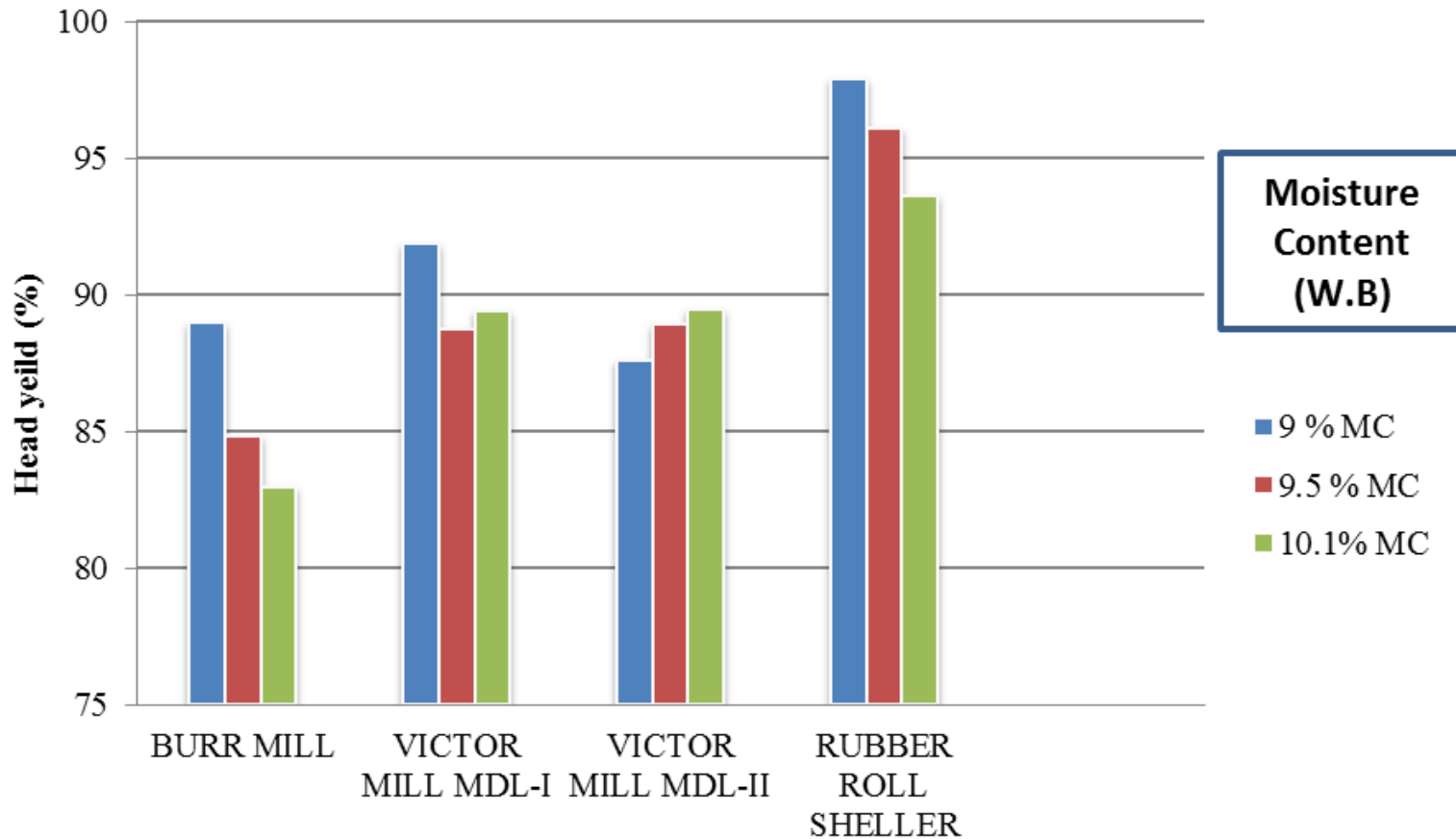


Fig. 3: Head yeild in four different millet mills for kodo millet at different moisture levels

Milling Characteristics

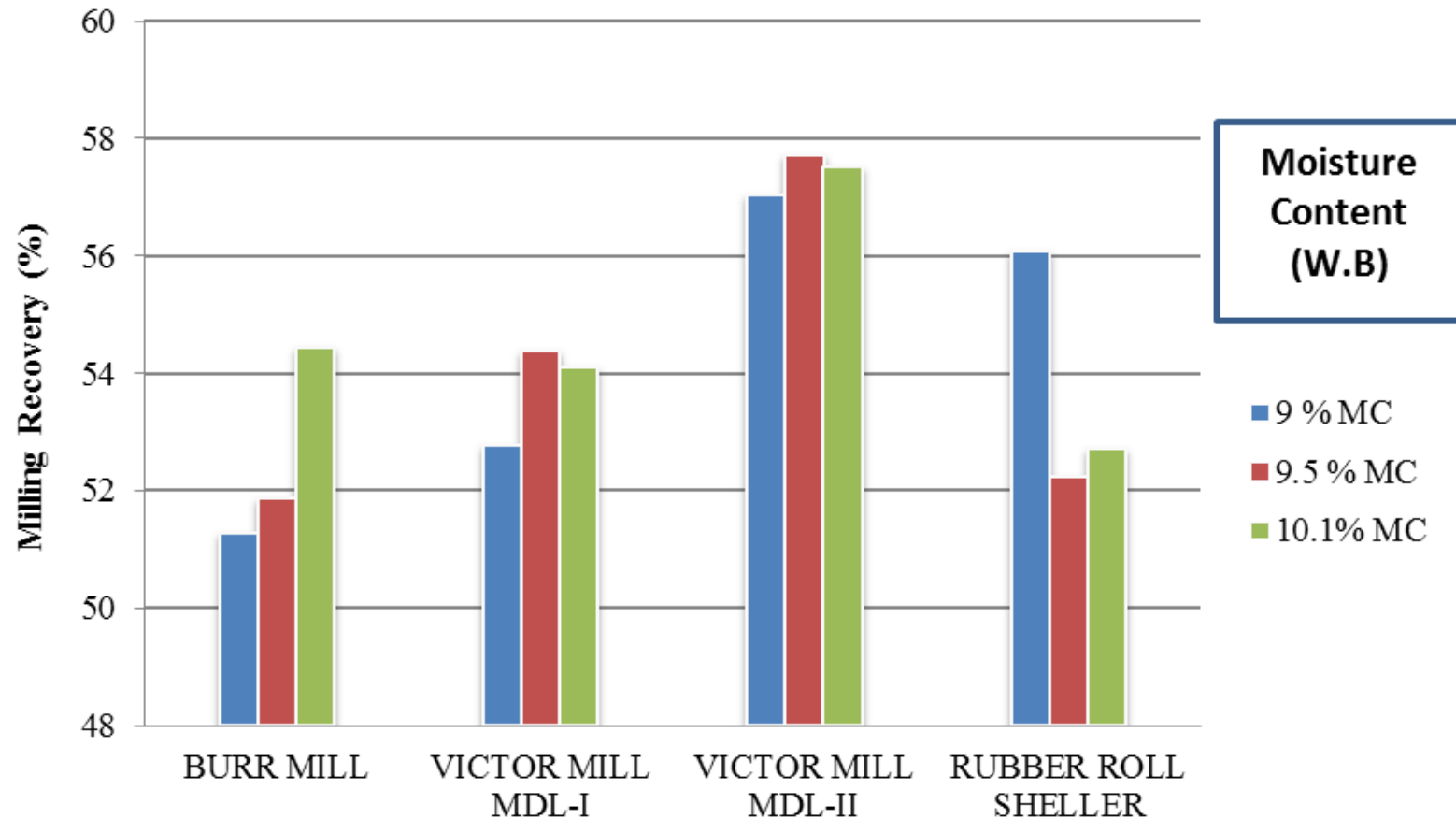


Fig. 2: Milling recovery in four different millet mills for kodo millet at different moisture levels

Milling Characteristics

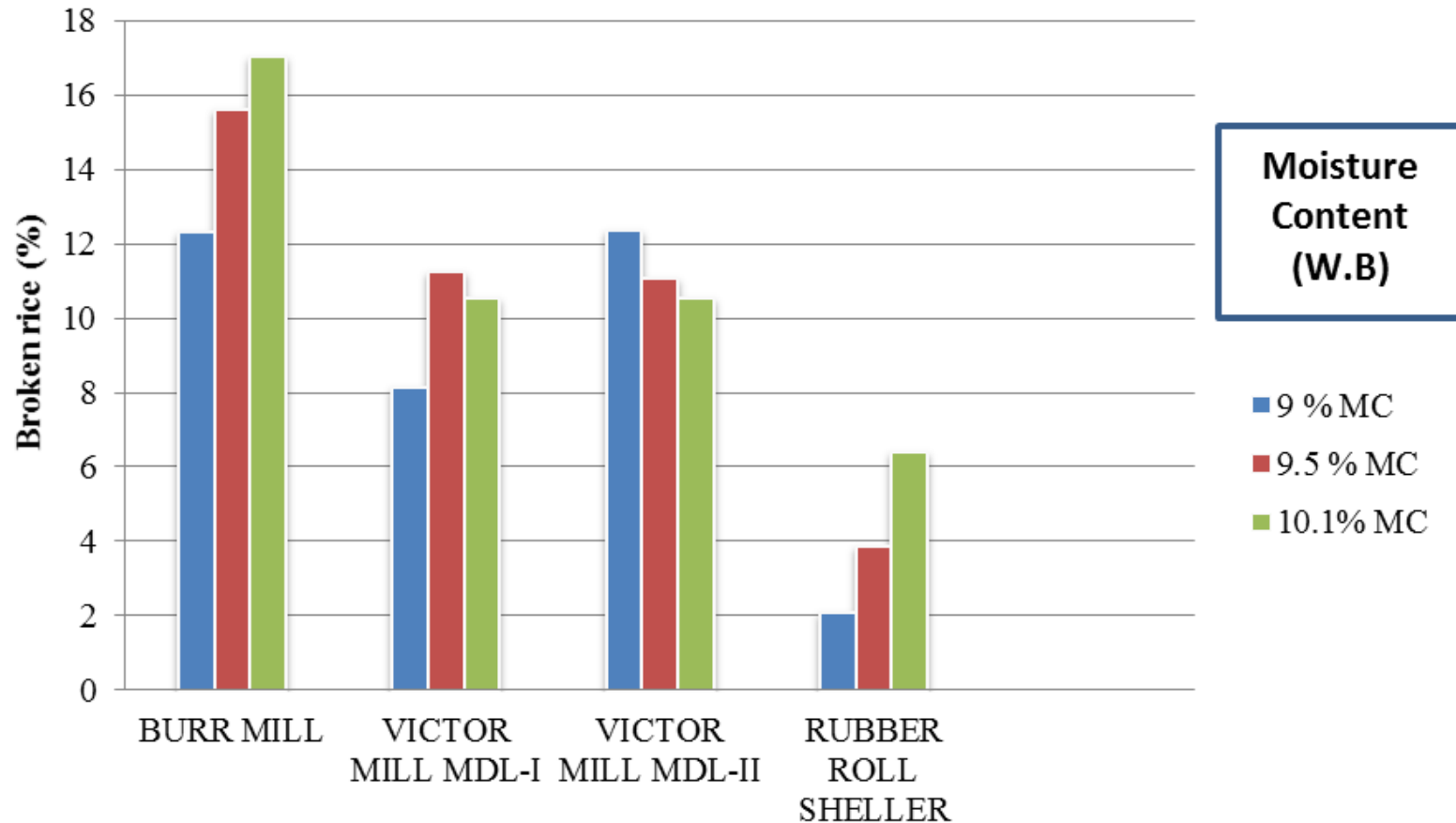


Fig. 4: Broken rice yield in four different millet mills for kodo millet at different moisture levels

Conclusion

❖ Among the four different dehulling equipments namely, burr mill, Victor millet mill model-I, Victor millet mill model-II and rubber roll sheller that were tested for hulling kodo millet, the Victor millet mill model -II was found to be best based on dehusking efficiency, milling recovery, head rice yield and broken yield