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MTU 1223 (Varsha), a high yielding, non-lodging rice variety released for Rainfed shallow lowland ecology of Odisha and Bihar

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Abstract
A high yielding, non lodging rice variety MTU 1223 (IET 25856) was developed from the cross between a high yielding low grain shattering pre release culture MTU 1081 and high yielding long duration variety MTU 1064 through pedigree method of breeding from 2007-2010. In station yield trials conducted at RARS, Maruteru between 2011-2013, it was recorded 27.4% higher grain yield over the national check MTU 7029. In multilocation testing pooled data over seven locations for two years indicated that MTU 1223 has recorded 15.5% yield advantage over the common check variety MTU 7029 (Swarna). In All India Coordinated trials, over all locations, it has recorded 11.59%, 7.99%, 9.27% and 7.13% higher yield than the National, Zonal, hybrid and Local checks respectively. In zone III (Eastern) it has shown superior performance over national, zonal, hybrid and local checks with 16.51%, 12.67%, 22.11% and 11.72% respectively. It was released as straight variety for rainfed shallow lowland ecology of Odisha and Bihar states in 54th Central Varietal Identification Committee meeting in 2019.

Keywords: Rice, rain fed shallow lowland ecology, new variety

Introduction
Rice is the staple food crop for more than 50% of world's population. In India, it is cultivated in 44 m ha with an average productivity of 108-110 m. tones. Rice is cultivated in different ecologies ranging from irrigated to upland and rainfed low land ecology is important one among them wherein nearly 20% of world's rice is under this ecology. It is very difficult to precisely define rainfed low land ecology because it is central in the continuum of rice cultures. The hydrology of this particular low land system overlaps with irrigated, upland, deep water systems. In India alone cultivation of different crops in rainfed lowland ecology is about 15 m.ha. The major setbacks in this ecology is drought, flooding, intermittent submergence which may occur at different stages of crop growth mainly depending upon the rainfall intensity and distribution and topography. The investment and the intensity of research on rainfed ecosystems is significantly low compared to irrigated ecosystems irrespective of the crop. For combating the abiotic stresses especially in rainfed ecosystem, management of natural resources is a short term strategy whereas development of climate resilient varieties is a long term strategy which is economical and ecofriendly. The focus on research needs to be shifted from unilateral approach (commodity based) to multilateral (ecosystem based production system) to maximize the productivity with shrinking resources like land, water etc. With the objective of enhancing the yield potential in the rainfed shallow lowland ecosystem, a high yielding, non-lodging, long duration variety (150 days) with low grain shattering with good grain quality and tolerant to BLB and Blast was developed at Regional Agricultural Research Station, Maruteru which was tested in All India Coordinated Research Project on Rice for a period of three years (2016 to 2018) and was released in CVRC as MTU Rice 1223, Varsha in 2019.

Material and Methods

A cross involving MTU1081, a high yielding short duration culture with low grain shattering used as female parent and MTU 1064, a high yielding rice variety with submergence tolerance was used as male parent was attempted during 2007 and after confirming the hybridity, the F_2 was raised and elite plants were selected and the subsequent generations (F_3 to F_6) in 2009 and 2010 were handled through pedigree method of breeding (Figure1). A Promising line MTU2035-12-4-2-3 was selected in F_6 generation and was promoted to yield trials in 2011 and was evaluated in different station trials [Observational Yield trial (OYT), Preliminary Yield Trial (PYT) and Advanced Yield Trial (AYT)] from 2011 to 2014 and state level multilocation testing was carried out in two years *viz.*, 2015 and 2016. It was nominated for AICRIP coordinated yield trials testing in 2016 and was tested for three years under IVT-RSL in 2016 and 2017 and AVT 1 RSL in 2018. The culture was screened for tolerance to pests and diseases under NSN (National Screening Nursery) of AICRIP from 2016 to 2018.

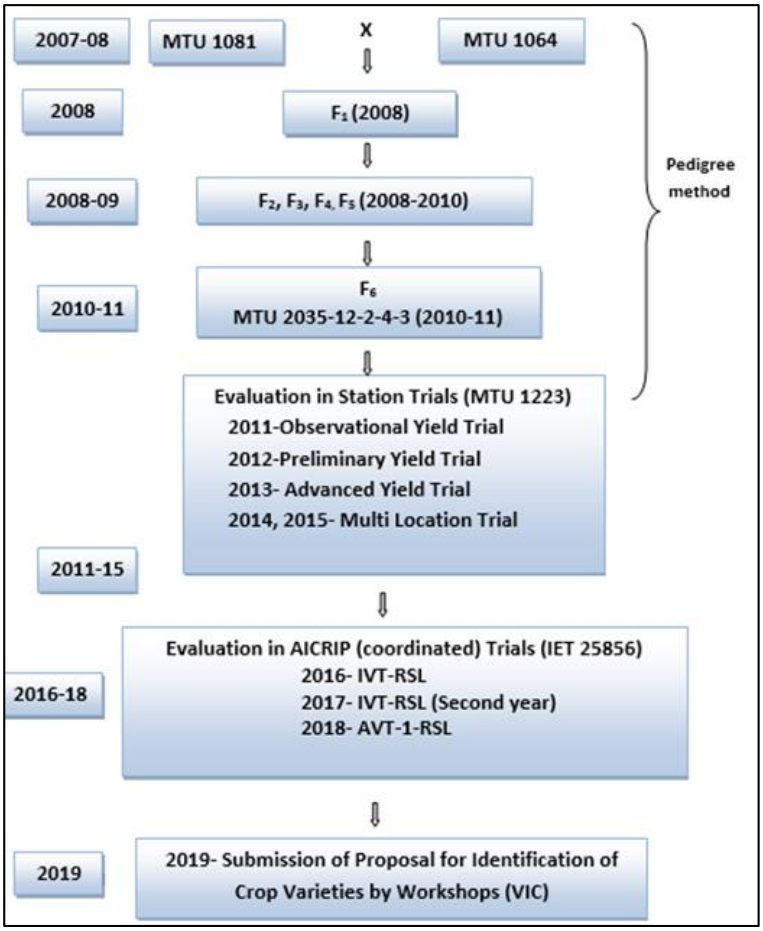

Fig 1: Flow chart details in the development of MTU 1223 (IET 25856)

Results and Discussion

The development of varieties in Pedigree Breeding depends upon the selection of single superior plants in the segregating generations (F_2 to F_6) by the concerned breeder (Chakravorty and Ghosh, 2012). In the current study, a cross was generated between MTU 1081 and MTU1064 to generate F_1 and superior plants were selected in segregating generations and an uniform elite line MTU 2035-12-2-4-3 was identified for testing under yield evaluation trials of the station.

Performance of MTU1223 in station trials and multilocation trials

The advanced line MTU 1223 (MTU 2035-12-2-4-3) was tested under Observational Yield Trial (Late) in 2011 recorded an yield of 6074 kg/ha whereas the check varieties MTU1061 (Indra) and MTU7029 (Swarna) recorded yield of 5617 kg/ha and 5039 kg/ha respectively (Table 1). In the preliminary yield trial (Late) conducted during *kharif* 2012 the genotype recorded 5.26% and 41.06% yield advantage over the over the check varieties MTU 1061 and MTU 7029 respectively. In the year *kharif* 2013, MTU 1223 was tested in advanced yield (Late) along with twelve other entries and two checks and the entry out yielded all the entries except one with an yield of 4321 kg/ha and an yield advantage of 10.82% and 25.46% was observed over MTU 1061 and MTU 7029 respectively. In the pooled data of multilocation testing of late duration entries during *kharif* 2014, the entry MTU 1223 has out yielded all the entries and has recorded highest yield of 5902 kg/ha against the common check MTU 7029 (5106 kg/ha) with an advantage of 15.58%. In the second year of multilocation testing during *Kharif* 2015 MTU 1223 recorded at par yield with the common check MTU 7029 in the pooled data.

Table 1: Performance of MTU 1223 (MTU 2035-2-2-4-3) under station trials and multilocation trials of ANGRAU

S. No	Name of the Trial	Code/ IET No	Year of testing	Grain yield (kg/ha)		Percentage increase over check
				Entry (MTU 1223)	Check	
1	OYT- LATE	AL 628	*Kharif* 2011	6074	5617 (MTU 1061)	9.03
					5039 (MTU 7029)	20.53
2	PYT –LATE	BL 264	*Kharif* 2012	5215	4954 (MTU 1061)	5.26
					3697 (MTU 7029)	41.06
3	AYT-LATE	CL 323	*Kharif* 2013	4321	3899 (MTU 1061)	10.82
					3444 (MTU 7029)	25.46
4	MLT-LATE (I year) (Maruteru)	L 485	*Kharif* 2014	5150	4503 (MTU 7029)	14.36
5	MLT- LATE (I year) Overall (7 locations)	L 485	*Kharif* 2014	5902	5106 (MTU 7029)	15.58
6	MLT- LATE (II year)	L 499	*Kharif* 2015	2252	2185 (MTU 7029)	3.06
7	MLT (II year) Overall (7 locations)	L 499	*Kharif* 2015	4960	4294 (MTU 7029)	15.51
				4839	4038 (MTU 7029)	19.83

Performance of MTU1223 under All India Co-ordinated trials

The entry MTU 1223 was nominated in AICRIP trial (Initial Variety Trial – Rainfed Shallow Land) during 2016 and was designated as IET 25856. All through the three years of testing i.e. 2016-2018, IET 25856 performed well. The Variety MTU 1223 has exhibited very high yield potential in two states pertaining to zone 3 in India**.** Over all locations, it has recorded 11.59%, 7.99%, 9.27% and 7.13% higher yield than the National, Zonal, hybrid and Local checks respectively (Table 2). In zone III (Eastern) it has shown superior performance over national, zonal, hybrid and local checks with 16.51%, 12.67%, 22.11% and 11.72% respectively. (Table 3).

Table 2: Performance of MTU 1223 (IET 25856) under All India Co-ordinated trials

	Year of testing	No of trials / Locations	MTU 1223 (IET 25856)	NCV (Dhanarasi/ Swarnasub1)	ZC (Savitri)	HC (PA6444)	Local check (MTU 1064)
Mean grain Yield (kg/ha)	1st year 2016	12	4366	4083	4456	-	4250
	2nd year 2017	11	5617	4978	4931	4408	4649
	3rd year 2018	11	4977	4329	4427	4685	5048
Weighted Mean		34	4968	4452	4600	4547	4637
% increase Over checks	1st year 2016			6.93	-2.02	-	2.73
	2nd year 2017			12.84	13.91	27.43	20.82
	3rd year 2018			14.97	12.42	6.23	-1.41
	Weighted Mean			11.59	7.99	9.27	7.13

* NCV, National check variety; ZC, Zonal check; HC, Hybrid check

Table 3: Performance of MTU 1223 (IET 25856) over all locations in zone III (Eastern Zone)

	Year of testing	No of trials / Locations	MTU 1223 (IET 25856)	NCV (Dhanarasi/ Swarnasub1)	ZC (Pooja)	HC (PA6444)	Local check (MTU 1064)
Mean grain Yield (kg/ha)	1st year 2016	7	4180	4118	4703	-	4321
	2nd year 2017	7	5693	4701	4573	3810	4537
	3rd year 2018	7	6041	4841	4849	4879	5387
Weighted Mean		21	5305	4553	4708	4345	4748
% increase Over checks	1st year 2016			1.51	-11.12	-	-3.26
	2nd year 2017			21.10	24.49	49.42	25.48
	3rd year 2018			24.79	24.58	23.82	12.14
	Weighted Mean			16.51	12.67	22.11	11.72

* NCV, National check variety; ZC, Zonal check; HC, Hybrid check

Performance of MTU1223 under National Screening Nursery

The entry MTU 1223 was tested in National Screening nursery of Entomology and Pathology for three years (2016 to 2018). Based on the screening results, it was inferred that MTU 1223 (IET 25856) has moderate tolerance to bacterial leaf blight, leaf blast and neck blast among diseases and moderate tolerance to stem borer in insect pests.

Phenotypical characterization of MTU 1223 (IET 25856)

MTU 1223 (IET 25856) is a high yielding, tall plant type, semi erect flag leaf, more tillering, compact panicles with moderate tolerance to leaf & neck blast, BLB and suitable for rainfed shallow lands. Grains are medium slender with brown glume. It has high milling recovery (70%), high head rice recovery (65%) and desired amylose and gel consistency values with L/B ratio of 2.80. (Table 4 and 5 and Figure 2).

- Duration: 150 days
- Semi erect plant type
- Strong culm, Non-lodging
- Two weeks seed dormancy
- Resistant to Blast and BLB
- Low shattering of grains (<2%)
- Highly translucent kernels with high head rice recovery of 65%
- Medium slender grain with high market price and good consumer acceptability

According to Protection of Plant Varieties and Farmers Right Act (PPV&FRA), 2001 characterization of a variety is

prerequisite for providing protection to plant varieties based on distinctiveness, uniformity and stability (DUS) test apart from novelty. Therefore the characterization of MTU 1223 (IET 25856) was done according to the Guidelines for the Conduct of Test for Distinctiveness, Uniformity and Stability on rice given by PPV & FR Authority, GOI, New Delhi (2007) (Table 4). Further, DNA finger printing is a technique used to characterize the variety at molecular level and the DNA fingerprinting of MTU 1223 along with the male parent and check variety MTU 1064 was performed at Biotechnology laboratory of RARS, Maruteru utilizing 48 SSR markers (Figure 3 and 4).

For commercial cultivation, release and notification of a variety is a must and the variety should be recommended for specified agro-climatic zone and its ability to withstand typical stress conditions, and tolerance/resistance to pests and diseases needs to be mentioned. Further, it should also show distinct advantages over the existing equivalent released varieties (Virk, 2001). Hence, the present variety MTU 1223 (IET 25856) was released as Varsha for rainfed shallow lowlands of Odisha and Bihar in 54th Central Varietal Identification Committee meeting in 2019 and notification proposals were submitted to Central Sub-Committee on Crop Standards Notification and Release of Varieties in 2020.

Table 4: DUS Characters of MTU 1223 (IET 28586)

S. No	Characteristics	Description
1	Coleoptile: colour	White
2	Basal leaf: Sheath colour	Green
3	Leaf: Intensity of Green colour	Medium
4	Leaf: Anthocyanin colouration	Absent
5	Leaf: Distribution of Anthocyanin colouration	Absent
6	Leaf sheath: Anthocyanin colouration	Absent
7	Leaf sheath: Intensity of Anthocyanin colouration	Absent
8	Leaf: Pubescence of Blade surface	Present
9	Leaf: Auricles	Absent
10	Leaf: Anthocyanin colouration of Auricles	Absent
11	Leaf: Collar	Present
12	Leaf: Anthocyanin colouration of Collar	Absent
13	Leaf: Ligule	Present
14	Leaf: Shape of Ligule	Split
15	Leaf: Colour of Ligule	White
16	Leaf: Length of Blade	Long (47 cm)
17	Leaf: Width of Blade	Medium (1.5 cm)
18	Culm: Attitude (for floating Rice only)	-
19	Culm: Attitude	Erect
20	Time of Heading(50% of plants with panicles)	Late
21	Flag leaf: Attitude of Blade (Early observation)	Erect
22	Spikelet: Density of Pubescence of Lemma	Weak
23	Male sterility	Absent
24	Lemma: Anthocyanin colouration of keel	Absent
25	Lemma: Anthocyanin colouration of area below apex	Absent
26	Lemma: Anthocyanin colouration of Apex	Absent
27	Spikelet: Colour of stigma	White
28	Spikelet: Thickness	Thick
29	Steam: length (Excluding panicle, Excluding Floating Rice)	78 cm
30	Steam: Anthocyanin colouration of Nodes	Absent
31	Steam: Intensity of Anthocyanin colouration of Nodes	Absent
32	Steam: Anthocyanin colouration of Internodes	Absent
33	Panicle: Length of Main axis	29.04 cm
34	Flag leaf: Attitude of Blade (Late observation)	Semi erect
35	Panicle: Curvature of main axis	Semi straight
36	Panicle: Number per plant	9-10
37	Spikelet: Colour of tip of lemma	White
38	Lemma and palea: Colour	Brown
39	Panicle: Awns	Absent
40	Panicle: Colour of Awns	Absent
41	Panicle: Length of Longest Awn	Absent
42	Panicle: Distribution of Awn	Absent
43	Panicle: Presence of Secondary branching	Present
44	Panicle: Secondary branching	Straight
45	Panicle: Attitude of Branches	Semi straight
46	Panicle: Exertion	Mostly exerted
47	Maturity	Late
48	Leaf sequence	Medium
49	Sterile lemma	Straw
50	Grain: Weight of 1000 fully developed grains (g)	17.4
51	Hulling (%)	77.5
52	Milling (%)	69.6
53	Head rice recovery	64.4

54	Kernel length (mm)	5.5
55	Kernel width (mm)	1.96
56	L/B ratio	2.79
57	Grain type	Medium slender
58	Chalkiness	VOC
59	Alkali spreading value	7.0
60	Gel consistency	42.0
61	Amylose content (%)	23.83

Table 5: Grain quality characters of MTU 1223 (IET 28586)

S. No	Character	Description
1	Grain type	Medium slender
2	Hulling (%)	77.5
3	Milling (%)	69.6
4	Head Rice Recovery (%)	64.4
5	Kernel Length (mm)	5.5
6	Kernel Breadth (mm)	1.97
7	L/B ratio	2.79
8	Grain Chalk	Very occasionally present
9	Alkali spreading value	7.0
10	Amylose content	23.83
11	Gel consistency	42.0
12	Gelatinization temperature	Intermediate

Fig 2: Vivid presentation of MTU 1223 (IET 25856)

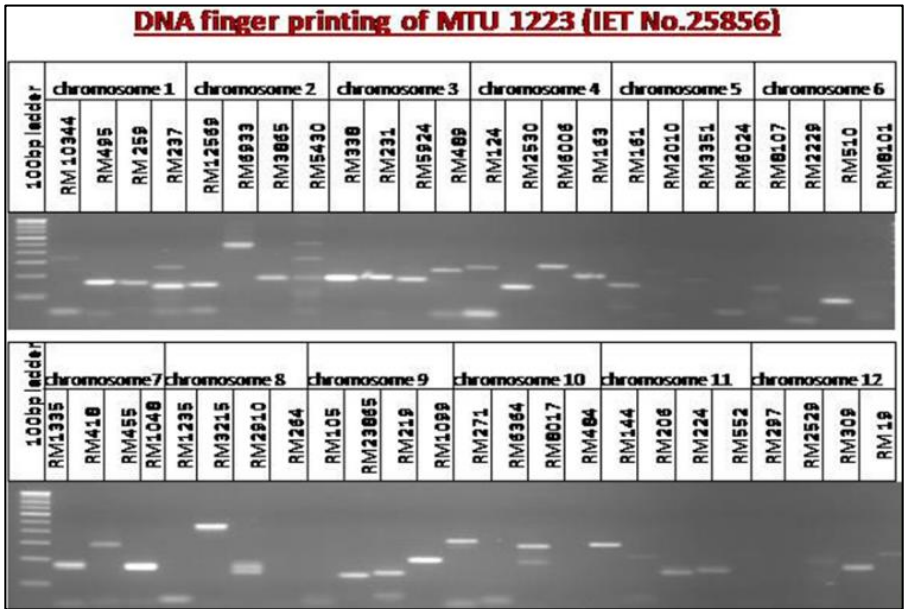

Fig 3: DNA Fingerprinting of MTU 1223 (IET 25856)

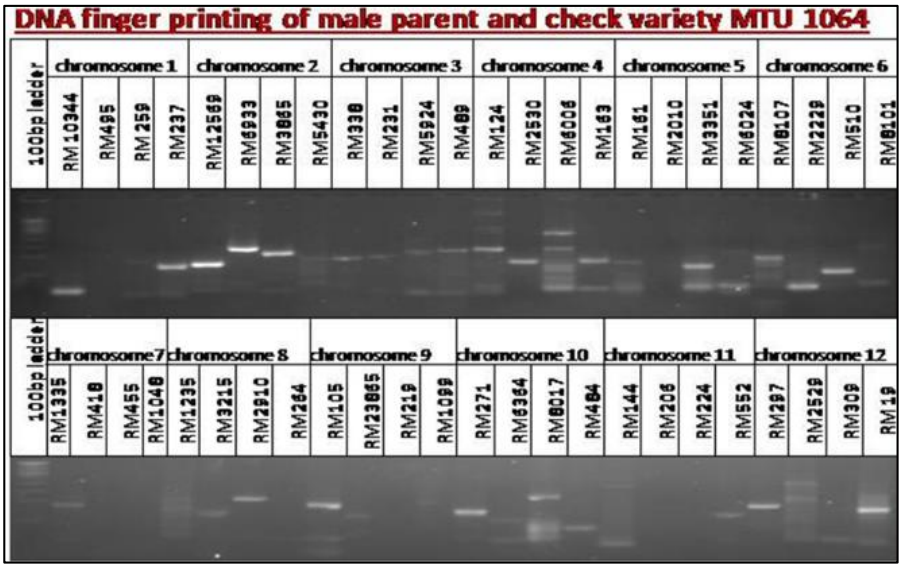

Fig 4: DNA Fingerprinting of Male parent and Check variety MTU 1064 (Amara)

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Conflict of Interest
The authors declare that they have no conflict of interest.

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