

Mahisagar (IET-22100): A superior early maturing fine grained rice variety with better quality

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ABSTRACT

Rice (*Oryza sativa* L.) is an important staple food of more than half of the world population and ¾th of the Indian population. In India rice is grown in 43 million hectare with 102.80 million tonnes production accounting productivity of 2390 kg./ha. In Gujarat rice is grown on an average about of 0.79 million hectares with a total production of 1.85 million tonnes with productivity of 2349 kg ha⁻¹.

So far in Gujarat, there is an urgent need to enhance the productivity and income of farmers, self sufficiency in rice production. Hence, systematic efforts were made to evaluate superior, early, medium slender kernel type variety with better cooking and milling qualities and inbuilt resistance to pests and disease at Main Rice Research Station, Anand Agricultural University, Nawagam. Mahisagar (IET-22100) a rice variety derived from the cross CN-540 x IR-50 and evaluated through pedigree selection method was tested in 20 trials conducted over 5 years at 5 locations of Middle and South Gujarat. On an average, the yield of Mahisagar (4593 kg ha⁻¹) was exhibited 29.8 per cent and 6.6 per cent higher over the checks GR-4 (3515 kg ha⁻¹) and GR-12 (4309 kg ha⁻¹), respectively. The plant type is erect with none-lodging, foliage is green with strong culm, spikelet is awnless and non shattering habit and easy to thresh. The cooking and milling qualities are better than the checks. The milling quality and head rice recovery was found 71.08 per cent and 62.4 per cent, respectively, hence fetches more price in market. The variety is early mature (121 to 125 days) with medium slender kernel type. It is less prone to pests and disease. Considering salient features, Mahisagar is well suited for commercial cultivation under irrigated, transplanted condition ecosystem in Middle and South Gujarat. The performance of Mahisagar variety was praised by farmers and traders and year by year becoming more popular in Gujarat.

Key words: Grain yield, cooking and milling qualities, mahisagar, pests and disease

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Rice (*Oryza sativa* L.) is the most important food crop and energy source for about half of the world's population and ranks second in production after wheat (Manjappa *et al.*, 2014). Rice occupies a unique position in many nations because of its importance in traditional diets and the main source of income of many peoples. It is considered the most popular and important field crop in India for several reasons: as a staple food after wheat, as an exporting crop, as a land reclamation crop for improving the productivity of the saline soils widely spread in southern part and coastal area of India and finally it is a social crop in which every person

of the farmers family could find work in rice fields and earn money during the growing season. Rice crop plays a significant role in India, as strategic crop for sustaining the food self-sufficiency. In India rice is grown in 43 million hectare with 102.80 million tonnes production accounting productivity of 2390 kg ha⁻¹. (Anon., 2015). In Gujarat rice is grown on an average about in an area of 0.79 million hectares with a total production of 1.85 million tonnes with productivity of 2349 kg ha⁻¹ (Anon., 2018).

So far in Gujarat, there is an urgent need to enhance the productivity, self-sufficiency in rice and enhance the income of farmers. Hence, systematic efforts were made to evaluate a superior early, medium slender kernel type rice variety with better cooking and milling qualities and inbuilt resistance to pests and disease. Keeping in view the above points, twenty rice genotypes were evaluated using pedigree selection method.

MATERIALS AND METHODS

The present investigation was carried out at the farm of Main Rice Research Station, Anand Agricultural University, Nawagam for five successive years during 2010 to 2014. The genotype Mahisagar (IET-22100) was developed through cross (CN-540 x IR-50) by using pedigree selection method. The genotype, Mahisagar (IET-22100) was evaluated for yield and yield attributing traits along with other promising entries including check varieties, Gujarat Rice 12 and Gujarat Rice 4. Initially, the yield performance was evaluated in small scale varietal trials (SSVT-E) at different four locations viz; Nawagam, Dabhoi, Dahod and Vyara in Gujarat. Further it was evaluated in large scale varietal trial (LSVT-E-F) in 13 trials at five different locations during Kharif 2012 to Kharif 2014. The Mahisagar (IET 22100) was also tested at Nawagam in IVT-IME, AVT-I-IME and AVT-II IME (AICRIP) trial during Kharif 2010, Kharif 2011 and Kharif 2012, respectively.

The experiment was laid out in a randomized block design (RBD) with three replications. Every genotype was grown with ten lines in net plot having 4.95 meter length and two meter width by keeping 20 cm x 15 cm plant spacing and all the recommended cultural practices for rice cultivation were applied. Fifteen quantitative and qualitative characteristics i.e. maturity days (seed to seed), plant height (cm), panicle length (cm), number of productive tillers/plant, 1000-grain wt (g), number of filled grains/panicle, grain length & breadth (mm), kernel length/breadth (mm), LB ratio, grain yield (kg/plot), reaction to diseases, reaction to major pests, hulling per cent and milling per cent were studied. The data pertaining to various characters were analyzed as per the statistical procedure of randomized block design given by Panse and Sukhatme (1969) for individual environments.

RESULTS AND DISCUSSION

Based on yield performance of genotypes, the promising line Mahisagar (IET-22100) was out yielded highest grain yield. Experimental results revealed that the variety Mahisagar (4593 kg ha⁻¹) had exhibited 29.8 per cent and 6.6 per cent higher yield over the checks GR-4 (3515 kg ha⁻¹) and GR-12 (4309 kg ha⁻¹), respectively. It was out yielded over GR-12 and GR-4 check varieties in 14/20 tests and 13/17 tests, respectively (Table 1). Whereas, in South Gujarat variety, Gujarat Navsari Rice-4 (GNR-4) performed 4409 kg ha⁻¹ grain yield reported by Mistry and Patel (2014). The crop growing period of Mahisagar was found (121-125 days) which is most desirable water saving traits mentioned in Table 2; whereas, the variety Gujarat Navsari Rice-4 (GNR-4) recorded 135-140 maturity days as mid late variety recorded by Mistry and Patel (2014).

Mahisagar showed early maturity (121 to 125 days) with medium slender kernel type. The yield potential of this variety is 8529 kg/ha (Table 1). The genotype, Mahisagar (IET-22100) was tested in 20 trials conducted over 5 years at different five locations of Middle and South Gujarat (Table 1). Mahisagar was early maturing determining by its days to 50 per cent flowering i.e. 91-95 days and seed to seed maturity i.e 121-125 days. The yield attributing

traits of Mahisagar viz; length of panicle (25-26 cm), panicles/sq.mt (289-299) and number of productive tillers/ plant (8-11) were found superior over both the checks (Table 2); these results are in agreement with those obtained by Sedeek *et al.* (2009). The Mahisagar culture is medium plant stature (115-125 cm, plant height) and possesses 17.0 to 17.6 gm test weight, 8.22-8.68 mm grain length and breadth 1.84-2.19 mm with kernel length/breadth (mm) ratio of 5.42/1.67, which is enough categorised in fine grain group with medium slender kernel type (Table 2). In case of diseases, bacterial leaf blight, leaf and neck blast are the major diseases of the paddy, whereas grain discoloration, sheath rot and stem rot are the minor diseases. The variety was tested for important pest and diseases of rice and showed resistance against leaf blast while moderate resistance to neck blast, bacterial leaf blight and grain discoloration (Table 5). In case of insect pests; stem borer, leaf folder and white backed hopper (WBPH) are the important pests of the paddy crop. The proposed strain showed moderate resistant reaction against stem borer, leaf folder and WBPH (Table 6). Screening of rice genotypes was carried out as per methodology suggested by Kalode

et al. (1979). The observations were recorded on the basis of 0-9 scale, when more than 90 per cent Taichung Native 1 (TN1) seedling lines were killed by the brown plant hopper insect. The whole reaction was completed in 8-14 days after the release of insects. Observations of seedlings were taken on the basis of visual plant damage symptoms (0-9 scale) which are followed by probing mark test was carried out according to methodology suggested by Natio (1964). The test was performed on 7 days old seedlings of selected resistant genotypes.

The Grain quality characteristics of the Mahisagar were derived at MRRS, Nawagam and DRR, Hyderabad which was mentioned in Table 4. The amylose content of Mahisagar in LSVT-E-F trial (K-2012 to K-2014) was analyzed and found at par in

Mahisagar (25.3%) to GR-4 (25.9 %) and GR-12 (25.8 %) (Table 4). The plant type is erect with none lodging, foliage is green with strong culm, spikelet is awnless and non shattering habit and easy to thresh (Table 2). Mainly, it has found the milling quality is 71.08 per cent with head rice recovery 62.4 % (Table 3). Farmers and traders have praised the performance of Mahisagar variety. Considering the recommendation of the eleventh meeting of Combined Joint Agricultural Research Council of SAUs (SAUs Agresco, 2015) and State Variety Release Committee (SSVC, 2015), the Mahisagar approved for Gujarat state by Department of Agriculture, Co-operation and farmer welfare, Government of Gujarat, moreover, Government of India had issued notification number wide S.O.3-62 (SD-4) on 8th March, 2018 to its official Gazette.

CONCLUSION

Better quality, multiple resistances, superior yielding and early duration culture, considering the salient features, Mahisagar is well suited for commercial cultivation and farmers economy ultimately welfare of the consumers and farmers under irrigated transplanted condition eco-system in Middle and South Gujarat.

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Table 1 Comparative performance of Mahisagar and mean over locations in Middle and South Gujarat

Sr. No	Name of Expt. & Year	Location	Grain Yield kg/ha			CD @ 5%	C.V.%
			Mahisagar (IET-22100)	GR-4	GR-12		
1	IVT-IME K-2010	NWG	5079	-	5079	1003	10.9
2	AVT-I-IME K-2011	NWG	6430	-	6106	1389	11.9
3	SSVT-E K-2011	NWG	4429	2102	3754	1209	16.3
		DAB	4600	3355	4491	1000	11.2
		DAH	3680	2110	3220	877	12.0
		VYA	5610	3392	3582	754	12.0
4	AVT-II-IME K-2012	NWG	2778	-	3623	729	13.2
5	LSVT-E-F K-2012	NWG	4505	2503	4271	358	5.9
		DAB	5214	4786	5214	639	6.3
		DAH	4020	4584	3939	609	8.3
		BAR	4328	4416	4034	492	7.2
		VYA	3382	3050	2847	365	6.8
6	LSVT-E-F K-2013	NWG	5895	2932	4136	807	10.0
		DAB	3789	4046	4929	393	5.9
		DAH	2368	3444	4125	800	13.6
		BAR	2972*	2387	1678	389	9.6
7	LSVT-E-F K-2014	NWG	8529*	4444	6634	814	7.5
		DAB	4929	4060	5969	722	8.1
		DAH	4473	3678	4282	771	9.7
		BAR	4846	4462	4265	765	10.3
Over all Av.			4593	3515	4309		
Over all % Inc			6.7				
Corrs. Mean of 17 Tests							
% Inc Over checks			6.6				
Corrs. Mean of 20 Tests			4309				
Out yielded tests							
34.9							
4563							
3515							
29.8							
4593							
13/17							
			14/20				

NWG :Nawagam,DAB:Dabhoi, DAH:Dahod, BAR:Bardoli and VYA:Vyara;* indicating significant level at 5 %

Table 2 Grain and Morphological descriptors of Mahisagar along with check

Descriptor details	Mahisagar	GR-4	GR-12
Days to 50% flowering (days)	91-95	90-92	90-95
Maturity Days	121-125	120-125	120-125
Plant height (cm)	115-125	110-115	115-120
Panicle length (cm)	25-26	20-22	25-26
No. of productive tillers/plant	8-11	7-8	7-9

No. of filled Grains/panicle	350-375	250-275	275-300
Panicle / sq.mt.	289-299	272-279	281-290
Grain length (mm)	8.22 – 8.68	7.26-7.92	7.86 – 8.34
Grain breadth (mm)	1.84 – 2.19	1.66 – 2.21	1.57 – 1.95
1000 grain wt. (gm)	17.0-17.6	14.5-15.5	16.5-17.6
Kernel length/breadth (mm)	5.42 / 1.67	4.91 / 1.62	5.04/1.56
Panicle length	25-26 cm	20-22 cm	25-26 cm
Panicle type	Well exerted	Well exerted	Well exerted
Plant type	Erect	Erect	Erect & Open
Foliage (Green with)	Strong culm	Strong culm	Strong culm
Lodging	Non-lodging	Non-lodging	Non-lodging
Spikelet	Awnless	Awnless	Awnless
Extra glume	Absent	Absent	Absent
Grain type	Fine/MS	Fine/SS	MS
Grain classification	Fine	Fine	Fine
Cooking	Good	Good	Good
Threshability(Non shattering)	Slight hard tothresh	Easy to thresh	Hard to thresh

Table 3 Grain quality characteristics of Mahisagar, MRRS, Nawagam and DRR, Hyderabad

Sr. No	Quality Characters	Mahisagar			Mean	GR-4	GR-12
		NWG2015	DRR2011	DRR2012			
		Nawagam	Hyderabad	Hyderabad			
Physical quality of Grain							
1.	HR (%)	81.9	80.9	81.5	81.43	78.38	74.98
2.	Mill (%)	71.08	66.8	72.5	70.13	69.88	68.68
3.	HRR (%)	62.4	61.7	64.7	62.93	60.94	61.50
4.	KL (mm)	5.42	5.06	5.44	5.31	4.91	5.04
5.	KB (mm)	1.67	1.84	1.91	1.81	1.62	1.56
6.	L/B ratio	3.25	2.75	2.84	2.95	3.03	3.23
7.	Grain Chalk	VOC	VOC	VOC	VOC	VOC	VOC
8.	Grain Type	MS	MS	MS	MS	SS	MS
Cooking Quality Characters of Grain							
9.	ASV	6.0	3.0	4.0	4.0	6.0	6.0
10.	VER.	4.14	-	-	4.14	4.42	4.03
11.	KLAC (mm)	8.6	-	-	8.60	8.4	8.8
12.	KER	1.59	-	-	1.59	1.71	1.75
13.	AC (%)	24.63	21.9	23.8	23.44	25.79	26.41
14.	WU (ml)	355	-	-	355	370	310
15.	GC	-	44	53	49	-	-

HR-Hulling recovery, HRR- Head Rice Recovery, KL- Kernel Length, KB-Kernel Breadth, L/B- Length Breadth ratio, ASV-Alkali Spreading Value, VER-Volume expansion Ratio, KLAC- Kernel length after Cooking, KER- Kernel elongation Ratio, AC-Amylose Content, WU-Water Uptake, MS-Medium slender

NWG indicating location, Nawagam and DRR indicating Directorate of Rice Research, Hyderabad and MRRS indicating Main Rice Research Station

Table 4 Mean of amylose content (%) of Mahisagar during trials of Kharif -2012 to Kharif-2014

Year	Mahisagar	GR-4	GR-12
Kharif -2012	25.0	24.0	24.4
Kharif -2013	24.0	27.1	26.4
Kharif -2014	26.5	26.5	26.7
Mean	25.3	25.9	25.8

Table 5 Reactions against major diseases of paddy (unprotected field condition screening nursery)

Sr. no	Year	Variety	Location	BLB	LB	NB	ShR	GDC
1	Kharif 2011	Mahisagar	NWG/NVS	5/3	0	3	5/5	5/5
		GR-4	NWG/NVS	9/3	9	5	5/3	7/3
		GR-12	NWG/NVS	7/3	0	3	0/3	3/3
2	Kharif 2012	Mahisagar	NWG/NVS	5/3	0	3	3/3	7/5
		GR-4	NWG/NVS	9/3	9	5	9/3	9/3
		GR-12	NWG/NVS	5/3	0	0	5/3	5/5
3	Kharif 2013	Mahisagar	NWG/NVS	5/3	0	0	3/3	3/5
		GR-4	NWG/NVS	9/5	9	3	3/5	3/5
		GR-12	NWG/NVS	7/5	0	1	5/3	3/3
4	Kharif 2014	Mahisagar	NWG/NVS	5/3	0	0	3/3	3/3
		GR-4	NWG/NVS	9/3	0	0	7/3	7/3
		GR-12	NWG/NVS	7/3	0	0	7/5	7/5

Damage scale %	BLB	LB	NB	FSm	ShR	GDR
Growth Stage	4-8	3-5	8-9	7-9	7-9	8-9
0	0	0	0	0	0	0
1	>1	>5	>1	>1	>1	>1
3	1-5	>1	1-5	1-5	1-5	1-5
5	6-25	11-25	6-25	6-25	6-25	6-25
7	26-50	26-50	26-50	26-50	26-50	26-50
9	51-100	76-100	51-100	51-100	51-100	51-100

SES, IRRI, 2013, diseases viz., LB and NB were screened at Nawagam(NWG) only; NVS=Navasari, BLB=bacterial leaf blast, LB= leaf blast, NB=neck blast, ShR=sheath rot, GDC=grain discoloration

Table 6 Reactions of Mahisagar against major pests of paddy (unprotected field condition screening nursery)

Sr.No.	Year	Name of Variety	Location	WBPH	SB	LF
1	Kharif 2011	Mahisagar	NWG/NVS	3/-	1/3	3/3
		GR-4	NWG/NVS	5/-	5/5	3/3
		GR-12	NWG/NVS	5/-	1/5	3/3
2	Kharif 2012	Mahisagar	NWG/NVS	1/0	3/3	5/1
		GR-4	NWG/NVS	1/1	5/5	7/3
		GR-12	NWG/NVS	3/1	3/5	5/3

3	Kharif 2013	Mahisagar	NWG/NVS	3/1	1/5	3/3
		GR-4	NWG/NVS	3/3	3/5	5/3
		GR-12	NWG/NVS	3/3	3/5	3/3
4	Kharif 2014	Mahisagar	NWG/NVS	0/1	3/3	3/1
		GR-4	NWG/NVS	0/3	5/3	5/1
		GR-12	NWG/NVS	0/3	1/3	3/3

Damage scale	No. WBPH/hill	% LF damage	SB % dead hearts	White earhead	
Growth Stage	2 – 9	2 - 9	2 - 4	8 - 9	
0	0	0	0	0	
1	>5	1-10	1-20	1-10	
3	5-10	11-20	21-40	11-25	
5	11-20	21-35	41-60	26-40	
7	21-40	36-50	61-80	41-60	
9	>40	50-100	81-100	61-100	

SES, IRRI, 2013

SB =stem borer

WBPH=white backed plant hopper

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