

'Swarna Shreya' rice

an aerobic variety for water-scarcity areas of central zone in India

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A new aerobic rice variety, 'Swarna Shreya' (IET 24003) was recommended for commercial cultivation under aerobic situation in Madhya Pradesh and Chhattisgarh in central zone in India. 'Swarna Shreya' rice has yield potential of more than 40 q/ha and showed superiority over national, regional, local varieties and hybrid check. 'Swarna Shreya' rice is a semi-dwarf (105 to 110 cm) variety which flowers in about 85 days and matures between 120 and 125 days. This variety showed high resistance to leaf blast disease and moderately resistance to neck blast, brown spot, sheath rot and RTD. It also showed moderately resistant against stem borer (dead heart), leaf folder, gall-midge (Biotype 1) and whorl maggot under natural screening. Quality-wise, this variety possesses high hulling recovery (77.5%), milling (69.2%), head rice recovery (56.2%) with desirable intermediate amylose content (21.87%) and alkali spreading value (ASV=4.0). It has high GC (65.5 mm) with very occasionally chalky indicating good cooking quality. 'Swarna Shreya' rice produces long bold grain, more number of grains per panicle with test weight of 23.7 g. This variety has importance in restricted irrigated areas/water-limiting areas and thus will contribute to increasing rice productivity and alleviate the socio-economic status of farmers in Madhya Pradesh and Chhattisgarh in central zone in India.

Key words: Aerobic variety, Central zone, Rice, Water

RICE (*Oryza sativa* L.) is one of the major staple food crops for about 65% of the world's population. It is cultivated under diverse ecologies ranging from irrigated to rainfed upland to rainfed lowland to deep water. In India, it is grown in nearly 44 million ha of land in the country with the productivity of 2.2 tonne/ha. This crop is grown all over the country in different cropping system. The major rice producing states are West Bengal, Uttar Pradesh, Andhra Pradesh, Telangana, Bihar, Chhattisgarh, Odisha, Assam and Tamil Nadu. Being an extravagant consumer of water, rice uses around 3,000 to 5,000 liters of fresh water to produce 1 kg of rice. Water scarcity is the most severe limitation to the productivity of rice in irrigated as well as rainfed systems.

A recent estimate on climate

change predicts the water deficit to deteriorate further in years to come and the intensity and frequency of drought are predicted to become worse. Scarcity of fresh water resource has threatened the production of the flood-irrigated rice crop. By 2025, 15 out of 75 million ha of Asia's flood-irrigated rice crop will experience water shortage. Aerobic rice is a new concept of growing rice: it is high-yielding rice grown in well-drained, non-puddled and non-saturated (aerobic) soils under supplement irrigation and high external inputs. Aerobic rice promises substantial water saving by minimizing seepage and percolation and greatly reducing evaporation.

The aerobic rice variety 'Swarna Shreya' (RCPR-8-IR84899-B-179-16-1-1-1) released and notified by the Central Sub-committee on Crop

Standards Notification and Release Varieties for Agricultural Crops, Government of India. In Chhattisgarh, rice occupies average of 3.6 million ha with the productivity of the State ranging between 1.2 and 1.6 tonne/ha depending upon the rainfall. In Madhya Pradesh rice is grown in the area of about 15.59 lakh ha with production of 14.62 lakh tonne and productivity 989 kg/ha which is far below than the average national productivity (2,010 kg/ha). Water scarcity is the major challenge to sustain the rice production in these areas. The rice crop grown in Madhya Pradesh and Chhattisgarh invariably suffer due to moisture stress in one stage or the other. Therefore, 'Swarna Shreya' rice is recommended for these states will not only increase the yield levels, but will also stabilize it at higher level of rice.

Yield potential and agronomic adaptation

The ‘Swarna Shreya’ rice (RCPR-8-IR84899-B-179-16-1-1-1) was entered as IET 24003 under IVT-Aerobic trial in AICRIP coordinated programme in wet season 2013 and has consistently outperformed the national, regional, local and qualifying check varieties under national testing from 2013 to 2015 at multilocations. Under three years of national testing, this variety exhibited stable yield and its contributing traits were in regions III, II and V. It was found to be promising for the aerobic areas of Chhattisgarh, Madhya Pradesh, Punjab and Bihar during 3 years in testing under AICRIP programme. The ‘Swarna Shreya’ rice (ET 24003) was evaluated in 32 trials in the different states of India between 2013 and 2015. Out of 32 trials, IET 24003 was 24 times in the top ranking for yield. Based on three years of testing, IET 24003 was recorded an overall mean grain yield 4,298 kg/ha and showed yield gain of 36.88%, 31.22%, 23.61% and 2.68% over national (CR Dhan 201), regional (MAS 946), local and hybrid (PA6129) checks, respectively. Besides, IET 24003 has out yielded qualifying entries *viz.*, IET 24035, IET 24036 and IET 24010 and recorded yield gain of 22.45%, 23.73% and 17.41%, respectively (Table 1). On over all mean in Chhattisgarh and Madhya Pradesh



where released and recommended, it yielded 69.02%, 47.15%, 32.77% and 14.24% higher than national (CR Dhan 201/IR64), regional (MAS 946-1), local checks (Danteshwari/Durgeshwari/ Indira aerobic-1) and hybrid (PA6129) checks, respectively with mean yield of 4,048 kg/ha. Besides, IET 24003

has out yielded qualifying entries *viz.*, IET 24035, IET 24036 and IET 24010 and recorded yield gain of 26.32%, 26.72% and 23.48%, respectively (Table 2). In Chhattisgarh, the yield superiority of IET 24003 over national, regional, local and hybrid checks were 49.61%, 34.97%, 36.50% and 7.96%, respectively with mean yield of 4,432 kg/ha. In Madhya Pradesh IET 24003 yielded 130.3%, 90%, 137.9% and 30.7% higher than national, regional, local varieties and hybrid checks, respectively with mean yield of 3,475 kg/ha.

During 2013, IET 24003 (‘Swarna Shreya’ rice) ranked first on

overall basis under AICRIP. It produced a mean (weighted mean) grain yield of 4,550 kg/ha which was 68.71%, 28.86%, 17.69% and 12.76% higher than the national, regional, local and hybrid check respectively. In 2013, it stood first in Chhattisgarh and second in both Odisha and Madhya Pradesh and recorded yield superiority of 51.54%, 23.23% and 55.08% over the best varietal checks respectively. During 2014, it recorded 18.97% more grain yield than the best variety check. It produced a mean grain yield of 3,919 kg/ha which is 30.94%, 9.79% and 8.42% yield advantage over best variety checks in regions III, IV and V, respectively. During 2014 this variety outperformed best check in Madhya Pradesh (3,642 kg/ha), Bihar (4,461 kg/ha), Punjab (3,613 kg/ha), Uttar Pradesh (5,172 kg/ha), Gujarat (3,983 kg/ha) and Tamil Nadu (6,214 kg/ha) with yield advantage 27.52%, 13.13%, 5.92%, 7.81%, 9.78% and 25.10%, respectively. During 2015, ‘Swarna Shreya’ rice ranked 4th with over all mean grain yield of 4,567 kg/ha and registered 31% higher yield than best check variety (national check). State-wise it ranked second in Bihar and Chhattisgarh with 35% and 16% yield advantage over best check respectively and ranked third in Telangana with 36% yield advantage over best check.

‘Swarna Shreya’ rice showed high

Table 1. Summary of mean grain yield (kg/ha) data (All India) in co-ordinated varietal trials (Aerobic rice trial, 2013-2015)

Items	Name of the trial	Year of testing	No. of locations	Swarna Shreya (IET 24003)	National check	Regional check (MAS 946)	Local check	Hybrid check (PA6129)	Qualifying varieties		
									IET 24035	IET 24036	IET 24010
Mean	IVT-aerobic	I year 2013	11	4,550 (1)	2,697	3,531	3,866	4,035	3,926	3,733	3,785
Yield	AVT 1-aerobic	II year 2014	13	3,919 (5)	3,294	2,977	3,136	4,008	3,267	3,287	3,571
(kg/ha)	AVT 2-aerobic	III year 2015	8	4,567(4)	3,499	3,409	3,496	4,684	3,333	3,420	3,635
		Weighted mean		4,298	3,140	3,275	3,477	4,186	3,510	3,474	3,661
% yield increase/decrease on weighted mean						36.88	31.22	23.61	2.68	22.45	23.73
% increase or					68.71	28.86	17.69	12.76	15.89	21.89	20.21
decrease over checks					18.97	31.64	24.97	-2.22	19.96	19.23	9.75
and qualifying varieties					30.52	33.97	30.64	-2.50	37.02	33.54	25.64
Frequency in the top 5 group					24/32	11/32	14/32	13/32	14/32	9/32	12/32

Note: The mean yield data given in table is pertaining to all tested states.

Source: DRR Annual Progress Reports 2013, 2014 and 2015

Table 2. Summary of mean grain yield (kg/ha) data (Chhattisgarh and Madhya Pradesh) in coordinated varietal trials (2013 to 2015)

Items	Name of the trial	Year of testing	No. of locations	'Swarna Shreya' (IET 24003)	National check	Regional check (MAS 946)	Local check	Hybrid check (PA6129)	Qualifying varieties		
									IET 24035	IET 24036	IET 24010
Mean	IVT-aerobic	I year 2013	3	4,702	2,505	2,376	4,025	3,638	3,787	3,906	3,837
Yield (kg/ha)	AVT 1-aerobic	II year 2014	3	3,405	2,146	2,635	2,039	3,284	2,734	2,550	2,550
	AVT 2-aerobic	III year 2015	2	4,033	2,604	3,488	3,100	3,791	3,037	3,095	3,533
		Weighted mean		4,048	2,395	2,751	3,049	3,543	3,204	3,195	3,278
	% yield increase on weighted mean				69.02	47.15	32.77	14.24	26.32	26.72	23.48
	% increase or				87.70	97.94	16.82	29.25	24.18	20.38	22.54
	decrease over checks				58.70	29.22	67.03	3.70	24.54	33.56	33.53
	and qualifying varieties				54.88	15.63	30.10	6.38	32.80	30.31	14.15
	Frequency in the top 5 group				6/8	1/8	1/8	0/8	4/8	1/8	2/8

Note: The mean yield data given in table is pertaining to the states recommended (Chhattisgarh and Madhya Pradesh)

Source: DRR Annual Progress Report 2013, 2014 & 2015

response to nitrogen (N) fertilizer application as compared to checks and qualifying varieties used in AICRIP trials. The yield reduction and yield gain at 50 % and 150 % of recommended nitrogen level indicated that the normal does of N is the most productive for this culture which is ranging between 100 and 120 kg N /ha depending on the native soil fertility. 'Swarna Shreya' rice is a semi-dwarf (105-110 cm) genotype which flowers in about 85 days, matures in 120-125 days and

produces 281 panicles m². This rice variety produces long bold grains, moderate tillering (10-12 tillers/plant), long panicle, high grain number per panicle with test weight of 23.7 g. The genotype showed non-lodging plant type and producing thick culm. 'Swarna Shreya' rice can be successfully grown under direct seeded aerobic condition during second fortnight of June with seed rate 25-30 kg/ha. It has also capacity to withstand moderate drought at different growth stages of crop.

Weeds are one of the major constraints to aerobic rice production system. Sequential application of pre-emergence herbicide pendimethalin 30 EC @ 1.5 kg/ a.i./ha within 1-2 days of sowing followed by bispyribac sodium 10% SC @ 20 g a.i./ha at 3-4 leaf stage of weeds between 15 and 20 days after sowing is advisable. If required one or two hand/mechanical weeding at 40 days after sowing and 60 days after sowing may be done. Inter-cultivation operation may be applied as and when needed.

Table 3. Major disease reaction of 'Swarna Shreya' rice (IET 24003) and other checks varieties between 2013 and 2015 (over all locations)

Diseases	Year of testing	'Swarna Shreya' (IET 24003)	National check (IR 64)	National check (CR Dhan 201)	Pathology check (TNI)	HC (PA6129)	Qualifying varieties		
							IET 24035	IET 24036	IET 24010
Leaf blast	2013 1 st year	2.9	4.4	NT	5.0	NT	3.5	3.6	3.4
	2014 2 nd year	3.3	4.6	3.5	4.6	3.1	3.9	5.6	3.1
	2015 3 rd year	3.9	3.4	4.3	5.7	3.8	4.9	4.5	4.1
	Mean	3.4	4.1	3.9	5.1	3.5	4.1	4.6	3.5
Neck blast	2013 1 st year	3.9	4.9	NT	5.1	NT	3.8	4.4	4.5
	2014 2 nd year	4.3	5.8	4.9	5.3	4.5	7.2	5.2	5.0
	2015 3 rd year	6.3	5.1	4.9	5.7	4.9	5.3	4.6	5.4
	Mean	4.8	5.3	4.9	5.4	4.7	5.4	4.7	5.0
Brown spot	2013 1 st year	4.7	4.9	NT	5.0	NT	5.0	4.8	5.3
	2014 2 nd year	4.4	4.0	4.0	3.7	4.5	4.1	4.5	4.7
	2015 3 rd year	4.2	NT	NT	NT	NT	4.3	4.5	4.8
	Mean	4.4	4.5	4.0	4.4	4.5	4.5	4.6	4.9
Sheath blight	2013 1 st year	5.2	5.8	NT	6.5	6.7	6.3	6.2	5.7
	2014 2 nd year	5.4	6.1	6.8	6.7	6.8	6.5	6.2	5.1
	2015 3 rd year	5.4	6.3	5.4	6.1	6.1	5.9	5.5	6.0
	Mean	5.3	6.1	6.1	6.4	6.5	6.2	6.0	5.6
Sheath rot	2013 1 st year	4.1	4.6	NT	4.3	NT	3.2	4.6	4.3
	2014 2 nd year	3.3	4.8	4.4	5.2	4.0	3.4	3.7	3.8
	2015 3 rd year	5.4	5.6	5.9	5.8	6.1	4.9	4.8	5.0
	Mean	4.3	5.0	5.2	5.1	5.1	3.8	4.4	4.4
RTD	2013 1 st year	3.3	4.6	NT	5.6	NT	4.0	4.7	4.8
	2014 2 nd year	4.5	5.0	5.5	6.0	5.5	6.3	6.3	5.7
	2015 3 rd year	2.4	4.2	2.8	4.2	2.3	2.8	3.4	2.4
	Mean	3.4	4.6	4.2	5.3	3.9	4.4	4.8	4.3

NT: Not tested; and Sources: Screening nurseries 2013, 2014 and 2015, Disease and Insect Pest, AICRIP, DRR, Hyderabad.

Table 4. Data on some important quality characteristics (2014 to 2015)

Quality characteristics	Year 'Swarna Shreya' (IET 24003)		National check (CR Dhan 201)	Regional check (MAS946)	Hybrid check (PA6129)	Qualifying varieties		
						IET 24035	IET 24036	IET 24010
Hulling (%)	2013	NT	NT	NT	NT	NT	NT	NT
	2014	77.0	79.0	78.3	80.6	80.9	79.9	75.0
	2015	77.9	77.1	78.1	81.0	78.5	79.3	76.7
	Mean	77.5	78.1	78.2	80.8	79.7	79.6	75.9
Milling (%)	2013	NT	NT	NT	NT	NT	NT	NT
	2014	69.7	70.1	57.0	71.7	71.8	68.9	67.1
	2015	68.7	66.4	67.5	70.6	66.2	68.5	67.7
	Mean	69.20	68.25	62.25	71.15	69.00	68.70	67.40
Head rice recovery (%)	2013	NT	NT	NT	NT	NT	NT	NT
	2014	60.2	63.6	51.6	67.1	61.4	55.7	60.0
	2015	52.1	47.0	54.8	59.1	46.6	51.0	54.4
	Mean	56.15	55.30	53.20	63.10	54.00	53.35	57.20
Grain chalkiness.	2013	NT	NT	NT	NT	NT	NT	NT
	2014	VOC	A	VOC	VOC	A	VOC	VOC
	2015	VOC	VOC	VOC	VOC	VOC	VOC	VOC
Alkali spreading value	2013	NT	NT	NT	NT	NT	NT	NT
	2014	4.0	7.0	4.0	7.0	5.0	4.0	4.0
	2015	4.0	7.0	4.0	7.0	4.0	4.0	3.0
	Mean	4.0	7.0	4.0	7.0	4.5	4.0	3.5
Amylose Content (%)	2013	NT	NT	NT	NT	NT	NT	NT
	2014	22.26	23.93	23.67	23.02	19.24	23.14	21.44
	2015	21.47	23.90	23.61	23.90	21.73	22.58	21.50
	Mean	21.87	23.92	23.64	23.46	20.49	22.86	21.47
Gel Consistency (mm)	2013	NT	NT	NT	NT	NT	NT	NT
	2014	65	54	58	52	22	70	51
	2015	66	61	55	45	65	31	58
	Mean	65.5	57.5	56.5	48.5	43.5	50.5	54.5

LS: Long slender, SB: Short bold, LB: Long bold, MS: Medium slender, VOC: Very occasionally present, NT: Not tested, A: Absent
Source: IIRR Annual Progress Report 2014 and 2015, Vol. 1.

Reaction to major diseases and insect pests

The 'Swarna Shreya' rice possesses high resistance against leaf blast disease and moderately resistance to neck blast, brown spot, sheath rot and RTD (Table 3). It also showed moderately resistant character against insect pest like stem-borer (dead heart), leaf-folder, gall-midge (Biotype 1) and whorl maggot under natural screening. For plant protection of 'Swarna Shreya' rice, prophylactic sprays of one dose of any systemic insecticide need to be sprayed as and when required. Soil application of carbofuron in nematode incidence is necessary. For controlling stem-borer, apply monocrotophos @ 0.5 kg/ha or granular insecticide carbofuran 3G @ 33 kg/ha or cartap 4G @ 25 kg/ha on the basis of ETL (one egg mass/m² or 5% dead heart). To control leaf folder, apply Monocrotophos 36 EC @ 1.3litre/ha or Quinalphos 25 EC @ 2litre/ha or Phosphamidon 85 EC @ 0.6 litre/ha or Cypermethrin 10

EC @ 1litre/ha. For controlling termite, apply Chloropyriphos (Dursban) @ 25 kg/ha before sowing.

Quality characters

Quality-wise, 'Swarna Shreya' rice showed high hulling recovery (77.5%), milling (69.2%), head rice recovery (56.2%), intermediate amylose content (21.87%) and alkali spreading value (ASV, 4.0). IET 24003 has high GC (65.5 mm) with very occasionally chalky indicating good cooking quality (Table 4). This rice variety produces long bold grain, long panicle, more grain number per panicle with test weight of 23.7 g.

SUMMARY

The released aerobic rice variety 'Swarna Shreya' rice showed significant yield superiority over national (CR Dhan 201), regional (MAS 946), local and hybrid (PA6129 check varieties. It was at par for most of the quality parameters in comparison to the checks. It has

56.2% head rice recovery, intermediate amylose content (21.87%), and alkali spreading value (ASV=4.0). It has high GC (65.5 mm) with very occasionally chalky and long bold grain indicating good cooking quality. This variety showed high resistance to leaf blast disease and moderately resistance to disease like neck blast, brown spot, sheath rot and RTD and insect pest like stem borer, leaf folder, gall-midge (Biotype-1) and whorl maggot. Adoption of high-yielding, good-quality, input-responsive and moisture stress tolerant aerobic 'Swarna Shreya' rice will play proactive and decisive role in developing sustainable food production and lead for food security among farm families in the water scarcity areas in Madhya Pradesh and Chhattisgarh region of central zone in India.

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