

Swarna Sukha Dhan: A high yielding, multiple stress tolerant rice variety with desirable grain quality traits

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Under the climate change scenario, frequent occurrence of drought has been identified as key to low productivity of rice in rainfed as well as water limiting irrigated areas in eastern India. A high yielding, multiple stress (drought, disease, and insect pest) tolerant rice variety, Swarna Sukha Dhan (IET 24692) has been released and notified for commercial cultivation under direct seeded condition in drought prone rainfed midland to upland ecology of Uttar Pradesh and Jharkhand. This rice variety is of short duration (110-115 days), high yielding (4.0-4.5 t/ha), multiple stresses tolerant with desirable grain and cooking quality traits. Quality wise, this variety possesses high hulling recovery (78.4%), milling (70.9%), head rice recovery (68.4%) with desirable intermediate amylose content (22.32%), alkali spreading value, desirable GC with very occasionally chalkiness indicating good cooking quality. Grains of this variety contain 23.1 ppm zinc and 11.8 ppm iron. Swarna Sukha Dhan shows moderate resistance to leafblast, brown spot, bacterial leafblight, brown spot, false smut, and rice tungro diseases and stem borer, leaf folder, brown plant hopper and whorl maggot insect pest. Adoption of this variety increases net income of farmers by ₹15000-20000/ha over the local cultivars. This variety has potential to increase rice productivity in drought prone rainfed as well as limiting irrigated areas and thus it will contribute to achieve the goal of doubling the income of farmers besides ensuring the food self sufficiency at regional as well as national level.

Keywords: Drought, Multiple stress, Rice, Swarna Sukha Dhan

RICE (*Oryza sativa* L.) is one of the most important staple food for more than two-thirds of the Indian population, and thus holds the key for food security and plays a pivotal role in national economy. It is cultivated under diverse ecological conditions, including irrigated, rainfed, deep-water, and upland environments. In India, rice is cultivated in ~45.77 million ha area with a production and productivity of 124.4 million tonnes and 2717 kg/ha, respectively. In eastern India, rice is cultivated across ~27.26 million ha, with 16.2 million ha under rainfed conditions and ~4.28 million ha prone to frequent droughts. Rice is main source of food for most of population of eastern states. Despite this, rice productivity in eastern states is low as compared

to developed states. Climate change is one of main reasons for the low productivity of rice in this region. The frequent occurrence of drought has been identified as the key to the low rice productivity in the eastern states. In the future, increasing frequency and intensity of droughts in changing climatic conditions will likely have a more negative impact on rice production and productivity in this region. In view of increasing population and fulfilling future food requirements, rice production needs to be increased by increasing its productivity, particularly of drought prone rainfed and water limited irrigated ecology.

Development of high yielding rice varieties with tolerance to multiple stresses can play an important role in increasing rice production. Under

the climate changing scenario, there is an urgent need to develop, disseminate and adopt high yielding multiple stress tolerant rice varieties to achieve the goal of doubling the income of farmers and to ensure the food self-sufficiency at regional as well as national level.

A high yielding multiple stress tolerant rice variety, Swarna Sukha Dhan (IET 24692) has been developed by the ICAR Research Complex for Eastern Region, Patna in collaboration with International Rice Research Institute (IRRI), Philippines. It has been released by State Seed Sub Committee (Uttar Pradesh) on 23.06.2021 and notified by the Central Sub-Committee on Crop Standards, Notification and Release of Varieties for Agricultural Crops, Government of India



Rice variety Swarna Sukha Dhan

(Notification number S.O. 500 (E) dated 24 December 2021), for the cultivation in the state of Uttar Pradesh. Thereafter, it has also been released by the State Seed Sub Committee (Jharkhand) and notified by the Government of India (Notification number S.O. 1056 (E) dated 6th March 2023), for the cultivation in the state of Jharkhand. It is suitable for cultivation under direct-seeded condition in drought prone rainfed and water limiting irrigated areas.

Swarna Sukha Dhan is an early duration (110-115 days), semi-dwarf, high yielding (4.0-4.5 t/ha), multiple stresses (drought, disease and insect pest) tolerant with desirable cooking quality traits and high micronutrients i.e., zinc (23.1 ppm) and iron (11.8 ppm) contents. It is resilient to changes in rainfall distribution. This variety showed desirable quality parameters like high head rice recovery (68.4%), intermediate amylose content (22.32%), alkali spreading value (ASV=4.0) and a soft GC with very occasionally chalky and medium slender grain type indicating

good cooking quality. This variety possesses semi-erect flag leaf, medium slender grain, long and well exerted compact panicle, moderate tillering (8-10 tillers/hill) with test weight of 24.3 g.

Target areas for cultivation

Rice variety Swarna Sukha Dhan is primarily targeted for cultivation under direct seeded condition in drought prone rainfed midland to upland ecology of the state of Uttar Pradesh and Jharkhand. It can also be cultivated in water limiting irrigated areas of eastern states where rainfall is inadequate to sustain the rice production.

Yield potential and agronomic adaptation

Rice genotype RCPR 16 (Swarna Sukha Dhan) was entered as IET 24692 under rainfed upland trial (early duration) in AICRP coordinated program during wet season of 2014. For three years (2014-2016) of national testing in AICRP program, this variety produced an average yield of 3.58 t/ha under early direct seeded trials (normal condition) and showed yield gain of 18.6, 29 and 24 over the national (Sahbhagi Dhan), zonal and local checks varieties, respectively. Whereas, under drought condition, this variety produced an average yield of 2.833 t/ha and showed yield gain of 17.6, 23.6 and 42.7% over national (Sahbhagi Dhan), zonal and local checks varieties, respectively (Table 1). In addition, during three years (2017-2019) of testing under the Sate

Varietal Trials (Uttar Pradesh) under rainfed condition, Swarna Sukha Dhan has recorded an overall mean grain yield 1.915 t/ha and showed superiority yield advantage of 11.48 and 19.63% over NDR 97 (best check) and Shusk Samrat (local check) respectively (Table 2). Additionally, based on three years (2018-2020) of testing under State Varietal Trials (Jharkhand), Swarna Sukha Dhan has recorded an overall mean grain yield 4.344 t/ha and showed yield advantage of 6.69, 4.96 and 16.31% over Sahbhagi Dhan, Lalat and IR 64 (drt 1), respectively. Under on-station (Jharkhand) trial, IET 24692 has recorded an overall mean grain yield 4.73 t/ha and showed yield gain of 9.74% over check variety Sahbhagi Dhan. In addition, under two-year adaptive trial conducted in Jharkhand state, Swarna Sukha Dhan has recorded an overall mean grain yield 4.769 t/ha, showed yield gain of 10.93% over check variety Sahbhagi Dhan

Swarna Sukha Dhan shows high response to fertilizer application as compared to checks. Yield reduction and yield gain at 50% and 150% of recommended nitrogen level indicated that normal dose of nitrogen is the most productive for this variety at most of the locations which is 90 kg N/ha depending on the native soil fertility. Recommended dose of fertilizer for this variety is 90:40:40 kg/ha of NPK respectively. Swarna Sukha Dhan is a semi-dwarf (105-110 cm) genotype which flowers in ~80-85 days, matures in 110-115 days. The



Grains and kernels of Swarna Sukha Dhan

Table 1. Mean grain yield (t/ha) data of RCPR 16 [IET 24692 (Swarna Sukha Dhan)] in AICRIP coordinated varietal trials (Early direct seeded, 2014-2016)

	Name of the trial	Year of testing	No. of locations	Proposed variety RCPR 16 (IET 24692)	National check (Sahbhagi Dhan)	Zonal Check	Local Check	Qualifying varieties		
								IET 24679	IET 24677	IET 25125
Normal condition										
Mean yield (kg/ha)	IVT-E-DS	2014	2	2.653	2.862	1.691	2.617	2.435	2.401	NT
	AVT 1-E-DS	2016	3	4.201	3.125	3.499	3.068	NT	NT	2.930
	Weighted mean		5	3.582	3.020	2.776	2.888	2.435	2.401	2.930
% Increase/decrease over weighted mean					(+)18.6	(+)29.0	(+)24.0	(+)47.1	(+)49.2	(+)22.3
Drought condition										
Mean yield (kg/ha)	IVT-E-DS	2014	1	2.833	2.410	2.292	1.986	2.806	1.897	NT
	Weighted mean		1	2.833	2.410	2.292	1.986	2.806	1.897	NT
	% Increase/decrease over weighted. mean				(+)17.6	(+)23.6	(+)42.7	+0.96	+49.3	NT

Note: The mean yield data given in table is pertaining promising states. Source: ICAR-IIRR Annual Progress Report 2014, & 2016 Vol. 1, Varietal Improvement.

Table 2. Mean grain yield (t/ha) data of RCPR 16 [IET 24692 (Swarna Sukha Dhan)] in State Varietal Trials (rainfed trial, 2017-19), Uttar Pradesh

Year of testing	No. of Locations	RCPR-16 (IET 24692)	Check Variety 1 (NDR 97)	Check Variety 2 (Shusk Samrat)	Qualifying Variety 1 (RCPR- 17)	Qualifying Variety 2 (RCPR-20)
2017	6	1.478	1.433	1.274	1.450	1.351
2018	8	2.082	2.062	1.959	1.451	1.262
2019	5	2.172	1.506	1.803	1.605	1.471
Weighted Mean		1.915	1.718	1.601	1.478	1.375
% Increase/decrease over weighted mean			(+)11.48	(+)19.63	(+)29.54	(+)39.25

Source: Three years (2017-2019) RATDS Kharif Report, Department of Agriculture, Uttar Pradesh.

best rice variety produces medium slender grains, moderate tillering, long panicle, high grain number per panicle with test weight of 24.3 g. Best time period for sowing of Swarna Sukha Dhan is from 2nd to 4th week of June. Direct seeding is either done manually or through seed cum-fertilizer drill machine in shallow furrows of 3-5 cm depth @ 25-30 kg/ha. For good crop stand, recommended row spacing is 20 cm apart. It is advisable to go for light irrigation just after sowing to ensure proper germination. Progressive application of pre-emergence herbicide Pendimethalin 30EC @ 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 15-20 DAS is advisable for proper weed control. If required, one or two hand/mechanical weeding at 40 DAS and 60 DAS may be done. Inter-

cultivation operation may be carried out when needed for effective weed management. Swarna Sukha Dhan, being a drought tolerant rice variety, does not require more water if rainfall is normal and well distributed. However, under severe drought conditions, fields should be irrigated at the critical stages like active tillering, panicle initiation, flowering and grain filling for getting good yield.

Reaction to major diseases and insect pests

Rice variety Swarna Sukha Dhan showed resistance to false smut and moderate resistance to leaf blast, BLB, brown spot, sheath blight, and RTD diseases. Moreover, under artificial screening, it also showed resistance to leaf blast disease. Although rice variety Swarna Sukha Dhan has tolerance to major diseases, regular monitoring of

the crop is advisable to know disease appearance and need based management is required. Seed treatment with fungicides like Carbendazim 50 WP @ 2g/kg seed or Tricyclazole 75 WP @ 1.5g/kg seed is advisable to reduce intensity of fungal diseases. Rice variety Swarna Sukha Dhan has also recorded resistant against stem borer (dead heart and white ear head), and leaf folder and moderately resistant against whorl maggot and BPH under natural conditions but need based application of insecticides is recommended to manage the insects. For proper plant protection, prophylactic sprays of one dose of any systemic insecticide need to be sprayed as and when required.

Quality characters

Quality wise, Swarna Sukha Dhan shows high hulling recovery (78.4%), milling (70.9%), head rice

recovery (68.4%), intermediate amylose content (22.32%) and alkali spreading value (4.0). It has desirable GC with very occasional chalkiness indicating good cooking quality. This rice variety produces medium slender grain, with test weight of 24.3 g. Grain of Swarna Sukha Dhan contains high amount of zinc (23.1 ppm) and iron (11.8 ppm).

Economic benefit

In rainfed as well as water limiting irrigated areas, adopting this variety gives a yield advantage of 0.7 to 1.0 t/ha over their local cultivated cultivars. Therefore, farmers can get a net benefit of ₹15000 to 20000/ha by adopting this variety. In this regard, this variety has much importance and potential in improving the livelihood of farm families in this region, where frequent drought is a common phenomenon.

SUMMARY

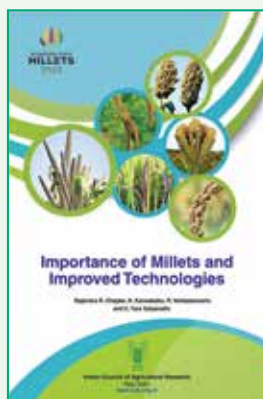
Under changing climate scenario, frequent occurrence of drought has been identified as key to low rice productivity in rainfed as well as water limited irrigated areas of eastern India, threatening food security of this region. The released and notified multiple stress tolerant rice variety Swarna Sukha Dhan shows significant yield superiority over national, zonal, and local check varieties in eastern states, particularly in Uttar Pradesh and Jharkhand. It shows desirable grain and cooking quality traits with high head rice recovery (HRR). This variety also shows high micronutrients i.e., zinc (23.1 ppm) and iron (11.8 ppm) contents. Swarna Sukha Dhan is suitable for cultivation under direct-seeded condition in drought prone rainfed and water limiting irrigated

areas. This variety shows moderate resistance to most of the major diseases and insect pests. In addition, adoption of Swarna Sukha Dhan also increases net income (₹15000-20000 /ha) of farmers over their local cultivated varieties. Adoption of high-yielding, multiple stresses (drought, disease, and insect pest) tolerant, good grain and cooking quality, high micronutrients (zinc and iron) contents, input-responsive rice variety Swarna Sukha Dhan will play substantial role in increasing productivity of rice and lead for food security among farm families in the drought prone rainfed and water limited irrigated areas in Uttar Pradesh and Jharkhand as well as other eastern states.

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TECHNICAL ASPECTS

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