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NLR 3186: A Long Duration Blast Resistant Rice Culture Suitable for Irrigated Ecology of Andhra Pradesh

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Abstract

The culture NLR 3186 was derived from a cross of NLR 28523 / Secandro Brazelio (5720-11-1-3-1) through Pedigree method of breeding at Agricultural Research Station, Nellore. It recorded an average yield increase of 19.97% over the check NLR 33892 in the station trials. In Multi Location Trial conducted for 2 years, it recorded 11.26% increase over the checks used for testing MTU 1061.I n 3 years of minikit testing the entry NLR 186 recorded 8.3% higher grain yield than the check varieties tested. In AICRIP trial during 2012-13, it recorded on par with the national check MTU 7029 (4249 kg/ha). It has non-lodging nature, high yielding, nitrogen responsive, with medium green foliage, low shattering and complete exertion of panicle. It was tolerant to leaf blast, neck blast and sheath rot. It has good cooking and chemical quality as it exhibits intermediate and desired values of ASV, gel consistency, good linear elongation ratio and amylase content. It also possesses good head rice recovery with translucent grains which is very much desired for marketing.

Keywords: Rice, blast, long duration, irrigated ecology.

Introduction

Rice is the staple food of millions and it has the ability to adopt to diverse agro-climatic conditions throughout the world. In India, rice occupies an area of about 44 million ha whereas in Andhra Pradesh it occupies 25 lakh hectares in *kharif* and *rabi* seasons. Nellore is one of the most important rice growing district in Andhra Pradesh where rice crop has been cultivated for three seasons *viz.,* early *kharif* (April-August), late *kharif* (August-January) and *rabi* (November-March) depending on the availability of irrigation water for rice cultivation. In early *kharif* season, short duration (120-125 days), in late *kharif*, long duration (150 days) and in *rabi* medium duration (130-135 days) varieties are generally cultivated in this area. *Molagolukulu* rice is the traditional rice cultivated in Nellore, Prakasam, Chittoor, Guntur and parts of Kadapa districts of Andhra Pradesh state. Generally *Molagolukulu* varieties are of long duration, tall statured, lodging prone, dark glumed grain, thick panicle and the grains are arranged in thread like manner on the rachis of the panicle. These varieties are suitable to plant even under aged nursery conditions (40-50 days aged seedlings) but having good cooking and keeping quality of cooked rice and good elongation of cooked rice grain. The cooked rice does not spoil even 20 hours after cooking. Due to irregularities in monsoon pattern, the area has drastically come down to 30,000 ha for these varieties. In spite of that, the single cropped area grown with rice crop is mostly

occupied by *Molagolukulu* varieties in this area. At agricultural Research station, Nellore more than 10 improved *Molagolukulu* rice varieties were released for cultivation long back. During 2006, NLR 33892 (Parthiva) variety was developed and released, which is a high yielding and blast tolerant, with thick panicles but under high nitrogen application it is prone to lodging. Because of health consciousness among the public, the demand is increasing again for *Molagolukulu* rice varieties. In view of the above, at Agriculture Research station, Nellore, NLR 3186 culture was developed to overcome the above said difficulties in *Molagolukulu* rice cultivation and as an alternative to NLR 33892 rice variety.

Material and Methods

NLR 3186 rice culture was developed at ARS, Nellore, ANGRAU by following pedigree method of breeding. This culture is a derivative of NLR 28523 x Secandro Brazelio. This is a long duration culture and the growing season was August month. It was tested for yield and its attributes at station level yield trails from 2009-10 to 2011-12. The culture was tested in multilocation testing in ANGRAU during 2012-13 and in 2017-18 under late maturity group trial. NLR 3186 was tested in AICRIP testing during 2012 *kharif* season as IET 23660 in locations across the country. It was tested for pest and diseases in AICRIP under NSN 2 nursery. It was tested in farmer's fields under minikit testing from 2017-18 to 2019-20 for three years in 168, 168 and 143 locations throughout the state in comparison with the various checks which are ruling in that particular area. The data on quality parameters in comparison with the checks were conducted ta RARS, Maruteru during 2017-18. It was deposited as an indigenous rice culture and IC number was got for further reference. The DNA finger printing data was generated by using different markers at RARS, Maruteru, ANGRAU.

Results and Discussion

The hybridization between NLR 28523 x Secandro Brazelio was attempted during 2003. The best progeny was identified during F6 generation. Later on yield trials were conducted at station level for 3 consecutive years from 2009-10 to 2011-12 and it recorded an average grain yield of 7272 kg/ha as against the check NLR 33892 (6030 kg/ha) which is 19.97% increase over the check. It was tested in multilocation testing during 2012 in 11 centres against the check MTU 7029 where it recorded an average grain yield of 6029 kg/ha which is 9.57% increase over the common check (5502 kg/ha) variety used. In the year 2017, again it was tested in MLT in 9 centres against MTU 1061 (common check) where it recorded 7346kg/ha which is 13.26% superior over the check (6485 kg/ha) used.

The performance of any culture is proven when it is tested under large scale area in the farmers field. The culture was tested for three consecutive years from 2017-18, 2018-19 and 2019-20 under minikit testing in 168, 168 and 143 farmers fields, respectively. In minikit trials the culture was tested against respective rice varieties grown in that particular area in different districts of Andhra Pradesh where it recorded an average grain yield of 6443 kg/ha as against the check 5950 kg/ha which is 8.3% increase over the check. The overall mean of the culture was 6815 kg/ha. (**Table 1**).

During 2013 *kharif* season NLR3186 was nominated and tested as IET23660 along with 63 entries under IVT-L trial in 9 centres all over India under AICRIP testing along with three checks (National, Regional and Local Checks). It recorded an average grain yield of 4249 kg/ha with the highest yield of 5093 kg/ha at Raipur centre. NLR3186 recorded an increased grain yield of 33% over the National Check at Bhubaneswar, 37.5% at Cuttack, 9% at Sharoli, 23.65% at Karnataka

Table 1: Yield performance of NLR 3186 at station, multilocation trials and at farmers' fields in Andhra Pradesh state

S. No.	Name of the Trial	Year and season of testing	Grain yield (Kg/ha)			Percentage increase over check
			NLR 3186	Name of the Check	Check yield	
1	OVT-L	2009-10 *Kharif*	8886	NLR 33892	6434	38.11
2	PVT-L	2010-11 *kharif*	6221	NLR 33892	5860	6.1
3	AVT –L	2011-12 *Kharif*	6709	NLR 33892	5796	15.7
4	MLT-I year	2012-13 - 11 locations	6029	MTU 7029 (Common check)	5502	9.57
5	MLT-II yr	2017-18 9 locations	7346	MTU 1061 (common check)	6485	13.26
6	Minikit trials at farmers fields	2017-18 (168 locations)	6373	NLR 33892/MTU 1061/ RGL 2537/BPT 5204	5828	9 .35
7		2018-19 (168 locations)	6372	NLR 33892/MTU 1061/ RGL 2537/BPT 5204/MTU 7029	5865	8.64
8		2019-20 (143 locations)	6585	NLR 33892/ MTU 1061/ RGL 2537/ BPT 5204/ MTU 7029	6158	6.93
		Average	6815		5991	13.45

b: Ancillary parameters

Name of the trial	Year and season of testing	Days to 50% flowering		Plant height (cm)		Panicle length (cm)		EBTS/m²	
		NLR 3186	Check NLR 33892	NLR 3186	Check NLR 33892	NLR 3186	Check NLR 33892	NLR 3186	Check NLR 33892
OVT-L	2009-10 *Kharif*	127	120	109.1	123.6	24.8	24.5	420	405
PVT-L	2010-11 *kharif*	124	124	96.5	107.3	24.5	24.3	495	424
AVT –L	2011-12 *Kharif*	122	125	109.2	118.6	24.8	24.3	568	524
	Average	124	123	105	117	25	24	494	451

- *The entry recorded 150-155 days duration for maturity.*

and 10.72% at Karaikal. On an average it recorded at par yield with national check Swarna. Except Nawagam centre, NLR 3186 surpassed the yield of Swarna (National Check) in the AICRIP testing. **(Table 2) (**ICAR-IIRR Annual Progress Report 2013, Vol. I, Page Nos. 1.215-1.226)

Table 2: Centre wise Performance of NLR 3186 (IET 23660) in All India Coordinated trials. Grain yield (Kg/ha) in IVT- (Late) *kharif*-2013

IET 23660 (NLR 3186) Grain Yield (Kg/ha)				
Place	**NLR 3186**	**National Check (Swarna)**	**Regional Check (Samba Mahsuri)**	**Local check**
Bhubaneswar	4138	3103	4138	4138
Cuttack	**4432**	3222	3524	4181
Chinsura	**3526**	4915	4434	5769
Raipur	5093	5489	4828	3042
Sharoli	4354	3993	4618	4347
Nawagam	2392	7562	7022	4398
Nellore	**4368**	4342	3414	3896
Karnataka	4772	3859	3589	5318
Karaikal	**5536**	5000	3732	6161
Overall Mean	**4249**	**4249**	**4393**	**4717**
DFF (days)	125	114	112	115
EBTs/Sq.m (No.)	271	288	293	282

Disease and Pest reaction

The culture was tested for various diseases at Agricultural research station, Nellore from 2010 to 2013 and it showed prominent tolerant reaction to leaf blast disease **(Table 3)** In AICRIP testing during 2013 it was tested in NSN 2 nursery, where it was found tolerant for both leaf and neck blast diseases. **(Table 4)**

Table 3a: Reaction of NLR 3186 to different diseases at A. R. S, Nellore

Year	Genotype	Leaf Blast	Neck blast	Bacterial Blight	Sheath rot
2009-10	NLR 3186	0	-	-	-
	NLR 33892©	4	-	-	-
2010-11	NLR 3186	1	-	-	-
	NLR 33892©	5	-	-	-
2011-12	NLR 3186	0	-	-	-
	NLR 33892©	6	-	-	-
2012-13	NLR 3186	1	7	5	5
	NLR 33892©	1	1	6	3
2013-14	NLR 3186	4	3	5	1
	NLR 33892©	5	3	5	3
	SI	1.6	5	5	3
In the station screening trials it was found tolerant to leaf blast.					

Table 3b: Reaction of NLR 3186 to insect pests at ARS, Nellore

Year	Variety	30DT (% damage)		
		Gall Midge	Dead Hearts	Leaf Folder
2009-10	NLR 3186	0	3.5	5.6
	TN 1	4.5	19.5	12.5
2010-11	NLR 3186	0	7.92	6.21
	TN 1	3.0	17.5	22.5
2011-12	NLR 3186	1.0	5.75	4.35
	TN 1	5.0	21.75	24.5

Table 4a: Reaction of NLR 3186 to Leaf blast at AICRIP testing during 2013

S. No.	Place	Blast disease score		
		Leaf Blast	Swarna	HR 12
		NLR 3186	National yield Check	National Susceptible check
1	Barapani	5	-	9
2	ICAR-IIRR	3	9	9
3	Lenova	4	8	9
4	Nellore	5	4	8
5	Almora	3	5	9
6	Gaghraghat	5	5	4
7	Ranchi	4	5	7
8	Varanasi	4	6	5
9	Mandya	2	6	4
10	Malan	1	5	8
11	Hazaribhag	3	3	5
12	Rewa	3	4	5
13	Coimbatore	4	5	4
14	Warangal	5	3	4
15	Jagdalpur	2	2	2
16	Pattambi	4	4	4
17	Maruteru	3	4	7
18	Rajendranagar	3	1	5
19	Karjat	3	5	3
20	Ponnampet	0	1	8
21	Gangavathi	2	2	2
	SI	3.1	4.3	5.5

- ***DS: Damage Score***

Table 4b: Reaction of NLR 3186 (IET23660) against insect pests in *kharif* 2013 (DRR Screening nurseries)

Place	Entry	BPH (DS)	WBPH (DS)	Green Leaf Hopper (DS)	Gall Midge Biotype 1% DP	Stem borer		Leaf Folder
						Dead hearts % DH	White ears % WE	% DL
ICAR-IIRR	TE	2.8	8.3		38.5			
	NC	9.0	7.2		-			
Ludhiana	TE	9.0				3.0 (65 DAT)		28.9 (65 DAT)
	NC	9.0				2.6		29.4
Gangavathi	TE	26.4 (62 DAT)	25.7				4.6 (Pre harvest)	10.7 (62 DAT)
	NC	5.6	5.8				0.9	3.6
Chinsura	TE					19.256 (DAT)	11.1 (93DAT)	
	NC					3.5	0.0	
SBP	TE					10.7 (50 DAT)		
	NC					5.3		
Rajen-dranagar	TE						1.1 (123 DAT)	
	NC						8.0	
Jagdalpur	TE			19	5.8 (50 DAT)			2.1 (50 DAT)
	NC			8	25.2			6.3
Bharapani	TE				80 (50 DAT)			
	NC				15			

Table 5: Response of NLR 3186 to Nitrogen fertilizer at A.R.S, Nellore

	2016		2017		2018		Mean	
	NLR 3186	BPT 5204	NLR 3186	BPT 5204	NLR 3186	BPT 5204	NLR 3186	BPT 5204
N 40	5187	4622	5284	4860	4676	4298	5049	4593
N 80	5288	5269	5559	5414	5541	5343	5463	5342
N 120	5517	5269	5330	5447	5660	4865	5502	5194
N 160	5624	5300	5739	5433	5096	4672	5486	5135
Mean	5404	5115	5478	5289	5243	4794	5375	5066

Summary: Among the four levels of nitrogen tested here, NLR 3186 responds even up to 160 kg N. the optimum dosage is 80 kg/ha.

According to Nagendra Reddy *et al*., (2016), in a study conducted on antibiosis and resistance mechanisms of resistance to BPH, the culture NLR 3186 (IET 23660) recorded resistant reaction against BPH (2 score) (TN1 susceptible check score:9, Resistant check PTB score: 2.1), low fecundity of BPH, low % of nymphal survival, longer nymphal duration, low growth of nymphs and less gain in body weight of BPH was observed when compared with the susceptible check TN 1.

Agronomic evaluation

The culture NLR 3186 was tested at four different nitrogen levels for three consecutive years from 2016-2018 where it recorded 5342 kg/ha at 80kg nitrogen application per hectare. It responds even up to 160 kg N but the optimum dosage is 80 kg/ha (**Table 5**).

Morphological features

The morphological features of the cultures are given in the **Table 6**. The culture flowered 120 days after sowing and it grows up to a height of 90-100 cm and bearing 12-15 tillers per plant. The panicle length is 25cm and the grains are in golden brown and having dark coloured furrows on the glumes. Short awns were present on the top grains in the panicle. The leaves were erect and showing delayed senescence at the time of maturity. Each panicle was fully exerted from the boot leaf and comprises 220 grains per panicle. The harvest index ranges from 60-65%. **(Table 6).**

Table 6: Description of NLR 3186

S. No.	Trait / Character	Description
1.	Plant height	90-100 cm
2.	Habit	Erect
3.	Days to 50% flowering	120-125 days
4.	Lodging	Non lodging
5.	Leaf blade colour	Medium Green
6.	Basal leaf sheath colour	Medium Green
7.	Leaf angle	Erect
8.	Flag leaf angle	Erect
9.	Leaf length	32 cm (medium)
10.	Leaf width	1.4 cm (medium)
11.	Leaf blade pubescence	Strong
12.	Ligule colour	White
13.	Ligule shape	Split
14.	Ligule length	3.2 mm
15.	Auricle colour	Pale green
16.	Collar colour	Pale green
17.	Culm angle	Erect
18.	Flag leaf angle	Erect
19.	Culm internode colour	Green
20.	Panicle length	25 cm
21.	Panicle type	Compact
22.	Panicle exertion	Well exerted
23.	Awns	Present on the top portion of the panicle
24.	Apiculus colour	Straw
25.	Stigma colour	White
26.	Lemma palea colour	Straw
27.	Lemma palea pubescence	Hairs on upper portion
28.	Seed coat colour (bran)	Dark brown
29.	Sterile lemma colour	Straw
30.	Senescence	Late
31.	Grain type	Medium slender
32.	Grain length (mm)	8.2
33.	Grain breadth (mm)	2.6
34.	Kernel length (mm)	5.52
35.	Kernel Breadth (mm)	1.82
36.	L/B ratio	2.98
37.	Hulling (%)	76.8
38.	Milling (%)	67.52
39.	Head Rice Recovery	65.64
40.	1000 grain weight	23.16g
41.	Chalkiness	Absent
42.	Gelatinization temperature	Intermediate
43.	Kernel elongation ratio	1.82
44.	Keeping quality	Good
45.	Grain shattering	<2%
46.	Flowering duration (days)	8-10
47.	Dormancy (weeks)	-
48.	Harvest index	60-65
49.	Filled grains/panicle	210-225
50.	Tillering ability	Moderate (7-14)
51.	Distinguishing characters	Compact, erect, Non-lodging, high yielding, dwarf with medium green foliage, dark brown glumed grains, medium slender, translucent grain with high grain number per panicle.

Quality features

After grain yield, second most important thing to consider is quality which includes physical, milling, cooking and chemical quality parameters. The culture NLR 3186 is a medium slender culture with a grain length of 8.2mm, width 2.6 mm and the kernel length of 5.5 mm, breadth 1.82 whereas the kernel L/b ratio was 2.98. The head rice recovery of the culture is 65% and it is acceptable recovery from the millers point of view. Absence of grain chalkiness and good kernel elongation ratio of 1.82 and volume expansion of 3.3 shows the good sign for cooking quality of the rice. The grain size belongs to medium slender group and the amylose content (24) and gel consistency (25 mm) are also under desirable limits (**Table 7**). In the organoleptic test conducted by the group of people and it was found to that the rice was flaky, non-sticky and good compatibility with curries while eating *i.e.,* good relishability.

Table 7: Grain quality data of NLR 3186

S. No.	Character	NLR 3186	BPT 5204	NLR 33892
1.	Grain type	Medium slender	Medium slender	Medium slender
2.	Kernel length (mm)	5.52	4.98	5.5
3.	Kernel Breadth (mm)	1.85	1.85	2.3
4.	L/B ratio	2.98	2.69	2.39
5.	Hulling %	76.80	75.67	77.6
6.	Milling %	67.52	67.21	73.6
7.	Head Rice Recovery	65.64	63.37	61.6
8.	Test Weight (gm)	23.16	14.2	18.2
9.	Rice Grain Type	Medium slender	Medium slender	Medium slender
10.	Grain Chalkiness	VOC	VOC	VOC
11.	Amylose content	24.2	23.4	25
12.	Alkali spreading value	5.0	4.0	3.0
13.	Water uptake	167.5	130	175
14.	Volume expansion ratio	3.3	3.3	3.5
15.	Kernal elongation ratio	1.82	1.74	1.8
16.	Gel consistency	25	24	24
17.	Aroma	NS	NS	NS

In view of the above it was concluded that the culture NLR 3186 possess good yielding ability at station level and also at framers fields, good milling and cooking quality traits along with blast resistance, suitable to sow from July to September month. Even under delayed transplanting conditions (aged seedlings) it was found to be suitable to cultivate in the irrigated rice ecology of Andhra Pradesh state.

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