

## Original Research Article

# Molecular and Morphological characterization of Narendra Sona: A Newly Released Rice Variety for Uttar Pradesh

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## ABSTRACT

### Keywords

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Narendra Sona (NDR 370133) a late duration rice variety was developed at Crop Research Station, Masodha, Faizabad, Uttar Pradesh. On basis of overall performance and moderately resistant to major diseases and pest of rice, this variety was released by SVRC, Uttar Pradesh for the commercial cultivation in U.P. Molecular and Agro-morphological characters of Narendra Sona was studied to identify the unique and distinct features of this variety.

## Introduction

Rice is the major cereal crop of India in terms of area, production and consumer preference. India is the second largest producer and consumer of rice in the world after china. The average rice production in India during 2011-12 was 104.32 million ton which accounts for 22.81% of global rice production. At current rate of population growth of 1.8% per annum, the rice requirement of the country is estimated to be around 140-160 million tonnes by 2020. To achieve this target in the next few decades, without harming the environment would be a great challenge. Uttar Pradesh is the 2<sup>nd</sup> largest rice producing state of the country with an area of 5.9 million ha and it has been fluctuating between 5.2 and 6.1 million ha

during the last decade. Average rice productivity of the state is about 2.80 t/ha. Development of new rice variety specific to prevalent ecology is one of the major solution to compete with the challenge of growing population. In view of the above observation Narendra Sona (NDR 370133) a new high yielding rice variety was developed at Crop Research Station, Masodha for irrigated ecology of Uttar Pradesh. NDR 370133 is developed with cross NDR 359/NDR 3026 using pedigree method of breeding. The overall yield advantage at the state levels is 16.36% over the check variety in the three year of testing in regional trials. It possesses good cooking quality with intermediate amylose content.

NDR 370133 is moderately resistant to major pests & disease of rice crop viz. bacterial leaf blight, sheath blight and blast. Performance of the NDR 370133 in On – Farm and Front Line Demonstrations was also very encouraging and it out yielded popular rice varieties of area in yield. NDR 370133 has established its yield superiority over most popular variety NDR 359 and may be good replacement for this variety as it has synchronous flowering which NDR 359 lacks. Information regarding Novelty, distinctness, uniformity and stability are basic requirement for the protection of varieties under Protection of Plant Varieties and Farmer's Rights ACT (PPVFRA), 2001. Hence, the molecular and morphological characteristics of the Narendra Sona (NDR 370133) was studied for DUS characterization of the variety.

## **Materials and Methods**

### **DUS Characterization**

The DUS characterization of the Narendra Sona (NDR 370133) was carried out at Crop Research Station, Masodha, Faizabad during kharif 2011. Geographically position of Masodha is 25.290 N latitude and 85.400E longitude and 113 m above the mean sea level. The relative humidity during crop season ranged from 80 to 95%. The soil of the experimental field was sandy loam in texture with very low organic carbon (0.42%). The pH of the soil was found 7.2. Nitrogen content of the soil was 200 kg/ha, available P<sub>2</sub>O<sub>5</sub> is 24 kg/ha and available K<sub>2</sub>O was 234 kg/ha. The experiment was laid down in randomized block design with three replications. The plot size of the experimental plots was 15 sqm and spacing of 20 cm between rows and 15 cm between plants was maintained to grow the crop. Recommended package of practices were adopted to raise the crop. Observations on

agro morphological traits were recorded at different growth stages of the crop for the DUS characterization of the Varieties per the national guidelines for DUS test in rice (table – 1).

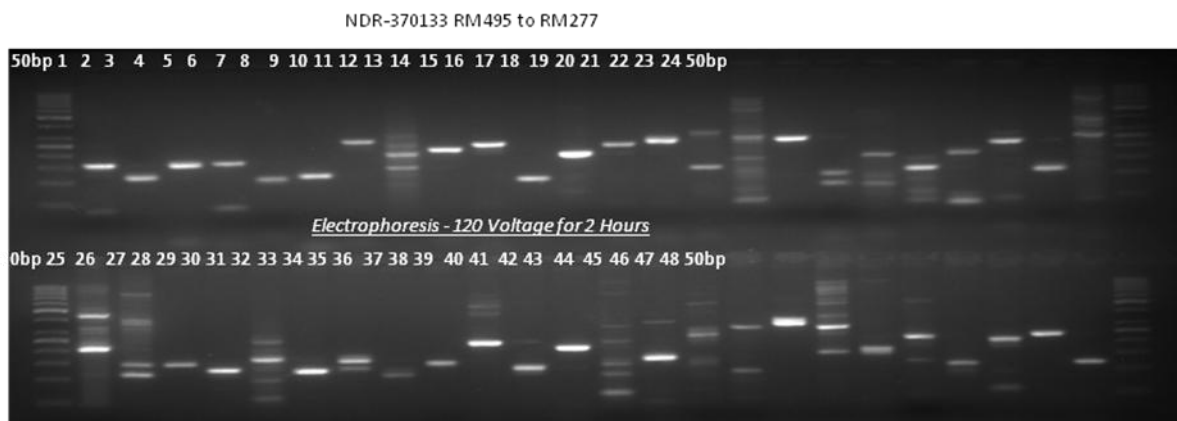
### **DNA Isolation and PCR Assays**

The genomic DNA was extracted from 10 days old rice seedlings as per Dellaporta *et al.*, (1993). PCR analysis was performed with 0.2 µl Taq DNA polymerase (5U/µl) (Biotools), 1 µl of genomic DNA 10 ng/µl, 1 µl of 10X buffer (Biotools), 0.5 µl of dNTPs (2.5 mM) and 1µl of each primer pair in a total volume of 10 µl. PCR was performed using thermal cycler (Applied Biosystems) following the PCR protocols reported earlier with necessary modifications. The amplified products were separated in 3% metaphor gel and visualized under phospho imager system after staining with ethidium bromide. The sizes of the amplified fragments were estimated visually using 100bp DNA ladder as size standard. Only clear and unambiguous bands of markers were scored. Band position of the prominent markers was depicted in table-2 & Fig.-1.

### **Results and Discussion**

The data depicted in table – 1 exhibit that Narendra Sona possess distinct, unique and stable morphological traits which differ it from the other varieties and land races. It is evident from the data that Narendra Sona is late maturing, good tillering ability and semi dwarf, rice variety. The basal leaf sheath colour is light purple in coloration while leaf: anthocyanin coloration is absent in the variety. Leaf: pubescence of blade surface is very weak and colorless auricles was present in the variety. Light purple colored ligule was present in the variety. The anthocyanin coloration of nodes and internodes is absent. It possess well exerted panicle.

**Fig.1** Major Markers and Band positions



**Table.1** DUS characteristics of NDR 370133

S. No.	Characteristics	States	Note	Stage of observation	Type of assessment
1	Coleoptile: colour	Colourless Green Purple	1 2 3	Germination	1
2. (*)	Basal leaf: sheath colour	Green Light purple Purple lines Purple	1 2 3 4	Vegetative growth	2
3	Leaf: intensity of green colour	Light Medium Dark	3 5 7	Vegetative growth	5
4	Leaf: anthocyanin colouration	Absent Present	1 9	Vegetative growth	1
5	Leaf : distribution of anthocyanin colouration	On tips only On margins only In blotches only Uniform	1 2 3 4	Vegetative growth	-
6	Leaf sheath: anthocyanin colouration	Absent Present	1 9	Vegetative growth	1
7	Leaf sheath : intensity of anthocyanin colouration	Very weak Weak Medium Strong Very strong	1 3 5 7 9	Vegetative growth	1
8 (*)	Leaf: pubescence of blade surface	Absent Weak Medium Strong Very strong	1 3 5 7 9	Vegetative growth	3
9 (*)	Leaf : auricles	Absent Present	1 9	Vegetative growth	9
10 (*)	Leaf: anthocyanin colouration of auricles	Colourless Light purple Purple	1 2 3	Vegetative growth	1

S. No.	Characteristics	States	Note	Stage of observation	Type of assessment
11	Leaf: collar	Absent Present	1 9	Vegetative growth	9
12	Leaf: anthocyanin colouration of collar	Absent Present	1 9	Vegetative growth	1
13	Leaf: ligule	Absent Present	1 9	Vegetative growth	9
14 (*).	Leaf: shape of ligule	Truncate Acute Split	1 2 3	Vegetative growth	1
15 (*).	Leaf: colour of ligule	Green Light purple Purple	1 2 3	Vegetative growth	2
16	Leaf: length of blade	Short Medium Long	3 5 7	Vegetative growth	3
17	Leaf: width of blade	Narrow Medium Broad	3 5 7	Vegetative growth	5
18	Culm: attitude (for floating rice only)	Non procumbent Procumbent	1 9	Vegetative growth	-
19 (+)	Culm: attitude	Erect Semi-erect Open Spreading	1 3 5 7	Vegetative growth	1
20 (*).	Time of heading (50% of plants with panicles)	Very early (<71 days) Early (71-90 days) Medium (91-110 days) Late (111-130 days) Very late (>130 days)	1 3 5 7 9	Vegetative growth	5
21 (* (+)	Flag leaf: attitude of blade (early observation)	erect semi-erect horizontal deflexed	1 3 5 7	Vegetative growth	1
22 (*).	Spikelet: density of pubescence of lemma	Absent Weak Medium Strong Very strong	1 3 5 7 9	Reproductive stage	1
23	Male sterility	Absent Present	1 9	Reproductive stage	1
24	Lemma: anthocyanin colouration of keel	Absent or very weak Weak Medium Strong Very strong	1 3 5 7 9	Reproductive stage	1
25	Lemma: anthocyanin colouration of area below apex	Absent Weak Medium Strong Very strong	1 3 5 7 9	Reproductive stage	1
26 (*).	Lemma: anthocyanin colouration of apex	Absent Weak Medium	1 3 5	Reproductive stage	1

S. No.	Characteristics	States	Note	Stage of observation	Type of assessment
		Strong Very strong	7 9		
27 (* )	Spikelet: colour of stigma	White Light green Yellow Light purple Purple	1 2 3 4 5	Reproductive stage	1
28 (+)	Stem: thickness	Thin Medium Thick	3 5 7	Maturity	7
29 (* )	Stem: length (excluding panicle; excluding floating rice)	Very short (<91 cm) Short (91-110 cm) Medium (111-130 cm) Long (131-150 cm) Very long (>150 cm)	1 3 5 7 9	Maturity	3
30 (* )	Stem: anthocyanin colouration of nodes	Absent Present	1 9	Maturity	1
31	Stem : intensity of anthocyanin colouration of nodes	Weak Medium Strong	3 5 7	Maturity	3
32	Stem: anthocyanin colouration of internodes	Absent Present	1 9	Maturity	1
33 (* ) (+)	Panicle: length of main axis	Very short (<16 cm) Short (16-20 cm) Medium (21-25 cm) Long (26-30 cm) Very long (>30 cm)	1 3 5 7 9	Maturity	7
34 (* ) (+)	Flag leaf: attitude of blade (late observation)	Erect Semi-erect Horizontal Deflexed	1 3 5 7	Maturity	1
35 (* ) (+)	Panicle: curvature of main axis	Straight Semi-straight Drooping Deflexed	1 3 5 7	Maturity	1
36	Panicle: number per plant	Few (<11) Medium (11-20) Many (>20)	3 5 7	Maturity	3
37 (* )	Spikelet : colour of tip of lemma	White Yellowish Brown Red Purple Black	1 2 3 4 5 6	Maturity	1
38	Lemma and Palea: colour	Straw Gold and gold furrows on straw background Brown spots on straw Brown furrows on straw Brown (tawny) Reddish to light purple Purple spots on straw Purple furrows on straw	1 2 3 4 5 6 7 8	Maturity	1

S. No.	Characteristics	States	Note	Stage of observation	Type of assessment
		Purple	9		
		Black	10		
39 (* )	Panicle : awns	Absent	1	Maturity	9
		Present	9		
40 (* )	Panicle: colour of awns (late observation)	Yellowish white	1	Maturity	1
		Yellowish brown	2		
		Brown	3		
		Reddish brown	4		
		Light red	5		
		Red	6		
		Light purple	7		
		Purple	8		
		Black	9		
41	Panicle: length of longest awn	Very short	1	Maturity	1
		Short	3		
		Medium	5		
		Long	7		
		Very long	9		
42 (* )	Panicle: distribution of awns	Tip only	1	Maturity	1
		Upper half only	3		
		Whole length	5		
43 (+ )	Panicle: presence of secondary branching	Absent	1	Maturity	9
		Present	9		
44. (+ )	Panicle: secondary branching	Weak	1	Maturity	1
		Strong	2		
		Clustered	3		
45 (* ) (+ )	Panicle: attitude of branches	Erect	1	Maturity	3
		Erect to semi-erect	3		
		Semi-erect	5		
		Semi-erect to spreading	7		
		Spreading	9		
46(* ) (+ )	Panicle: exertion	Partly exerted	3	Maturity	3
		Exerted	5		
		Well exerted	7		
47	Time of maturity	Very early	1	Maturity	7
		Early	3		
		Medium	5		
		Late	7		
		Very late	9		
48 (+ )	Leaf: senescence	Early	3	Maturity	7
		Medium	5		
		Late	7		
49 (* )	Sterile lemma: colour	Straw	1	Maturity	1
		Gold	2		
		Red	3		
		Purple	4		
50	Grain: weight of 1000 fully developed grains	Very low	1	Maturity	5
		Low	3		
		Medium	5		
		High	7		
		Very high	9		

S. No.	Characteristics	States	Note	Stage of observation	Type of assessment
51 (+)	Grain: length	Very short Short Medium Long Very long	1 3 5 7 9	Maturity	7
52 (+)	Grain: width	Very narrow Narrow Medium Broad Very broad	1 3 5 7 9	Maturity	5
53 (+)	Grain: phenol reaction of lemma	Absent Present	1 9	Maturity	1
54 (* (+)	Decorticated grain: length	Very short Short Medium Long Very long	1 3 5 7 9	Maturity	7
55 (* (+)	Decorticated grain: width	Narrow (<2.0 mm) Medium (2.0-2.5 mm) Broad (>2.5 mm)	3 5 7	Maturity	5
56. (* (+)	Decorticated grain: shape (in lateral view)	Short slender Short bold Medium slender Long slender Long bold Extra long slender	1 2 3 4 5 6	Maturity	5
57 (* (+)	Decorticated grain: colour	White Light brown Variegated brown Dark brown Light red Red Variegated purple Purple Dark purple	1 2 3 4 5 6 7 8 9	Maturity	1
58. (+)	Endosperm: presence of amylose	Absent Present	1 9	Maturity	9
59 (* (+)	Endosperm: content of amylose	Very low (<10%) Low(10-19%) Medium(20-25%) High(26-30%) Very high (>30%)	1 3 5 7 9	Maturity	7
60. (+)	Varieties with endosperm of amylose absent only Polished grain : expression of white core	Absent or very small Smal Medium Large	1 3 5 7	Maturity	-
61 (+)	Gelatinization temperature through alkali spreading value.	Low Medium High medium High	1 3 5 7	Maturity	3
62 (* (+)	Decorticated grain: aroma	Absent Present	1 9	Maturity	1

**Table.2** Molecular Characterization of rice variety Narendra Sona

SN	Markers	Forward Sequence	Reverse Sequence	NDR370133
				bp
1	RM495	AATCCAAGGTGCAGAGATGG	CAACGATGACGAACACAACC	150
2	RM1	GCGAAAACACAATGCAAAA	GCGTTGGTTGGACCTGAC	100
3	RM283	GGCATGAGAGTCTGTGATGTTGG	TAGTACTGCTCCATCTGCCTTGG	150
4	RM259	TGGAGTTTGAGAGGAGGG	CTTGTTGCATGGTGCCATGT	160
5	RM312	GTATGCATATTTGATAAGAG	AAGTCACCGAGTTTACCTTC	100
6	RM5	TGCAACTTCTAGCTGCTCGA	GCATCCGATCTTGATGGG	110
7	RM431	GCTTGCTTGTATCTGCATTGGTAGG	GGGATGATCCACTCTCTGTTTGG	270
8	RM154	GACGGTGACGCACTTTATGAACC	CGATCTGCGAGAAACCCTCTCC	150
9	RM452	CTGATCGAGAGCGTTAAGGG	GGGATCAAACCACGTTTCTG	250
10	RM489	ACTTGAGACGATCGGACACC	TCACCCATGGATGTTGTCAG	270
11	OSR-13	CATTTGTGCGTCACGGAGTA	AGCCACAGCGCCCATCTCTC	110
12	RM338	CACAGGAGCAGGAGAAGAGC	GGCAAACCGATCACTCAGTC	200
13	RM55	CCGTCGCCGTAGTAGAGAAG	TCCCGTTATTTAAGGCG	250
14	RM514	AGATTGATCTCCATTCCCC	CACGAGCATATTACTAGTGG	280
15	RM307	GTACTACCGACCTACCGTTCAC	CTGCTATGCATGAACTGCTC	150
16	RM124	ATCGTCTGCGTTGCGGCTGCTG	CATGGATCACCGAGCTCCCCC	300
17	RM507	TGCCCATGTATGTGAGGTACTCC	GCCTAATCCAGGACAAGCTACGG	280
18	RM413	CCAATCTTGTCTTCCGGATCTTGC	AGATAGCCATGGGCGATTCTTGG	100
19	RM161	TGCAGATGAGAAGCGGCGCTC	TGTGTCATCAGACGGCGCTCCG	200
20	RM178	TCGCGTGAAAGATAAGCGGCGC	GATCACCGTTCCTCCGCCTGC	150
21	RM334	GTTCAAGTTCAGTGCCACC	GACTTTGATCTTTGGTGACG	240
22	RM133	TTGGATTGTTTTGCTGGCTCGC	GGAACACGGGGTTCGGAAGCGAC	280
23	RM510	AACCGGATTAGTTTCTCGCC	TGAGGACGACGAGCAGATTC	150
24	RM454	CTCAAGCTTAGCTGCTGCTG	GTGATCAGTGACCCATAGCG	350
25	RM162	GCCAGCAAACCAGGGATCCGG	CAAGGTCTTGTGCGGCTTGCGG	200
26	RM125	ATCAGCAGCCATGGCAGCGACC	AGGGGATCATGTGCCGAAGGCC	120
27	RM11	TCTCCTCTTCCCCGATC	ATAGCGGGCGAGGCTTAG	160
28	RM455	CCACAAATTAATCCGGATCACACC	AGCATTGTGCAATCACGAGAAGG	110
29	RM118	CCAATCGGAGCCACCGGAGAGC	CACATCCTCCAGCGACGCCGAG	160
30	RM408	CAACGAGCTAACTTCCGTCC	ACTGCTACTTGGGTAGCTGACC	110
31	RM152	GAAACCACCACACCTCACCG	CCGTAGACCTTCTGAAGTAG	160
32	RM44	ACGGGCAATCCGAACAACC	TCGGGAAAACCTACCCTACC	160
33	RM284	ACTGCATGATCCTCCTCAGATCC	CCCTCTGATCTCTGATACTCCATCC	150
34	RM433	TGCGCTGAACTAAACACAGC	AGACAAACCTGGCCATTAC	200
35	RM447	CCCTTGTGCTGTCTCCTCTC	ACGGGCTTCTTCTCCTTCTC	140
36	RM316	CTAGTTGGGCATACGATGGC	ACGCTTATATGTTACGTCAAC	200
37	RM105	GTCGTCGACCCATCGGAGCCAC	TGGTCGAGGTGGGGATCGGGTC	80
38	RM215	CAAAATGGAGCAGCAAGAGC	TGAGCACCTCCTTCTCTGTAG	170
39	RM474	AAGATGTACGGGTGGCATTTC	TATGAGCTGGTGAGCAATGG	150
40	RM271	TCAGATCTACAATTCCATCC	TCGGTGAGACCTAGAGAGCC	110
41	RM171	AACGCGAGGACACGTACTTAC	ACGAGATACGTACGCCTTTG	380
42	RM484	TCTCCCTCTCACCATTTGTC	TGCTGCCCTCTCTCTCTCTC	200
43	RM552	CGCAGTTGTGGATTTCAAGTG	TGCTCAACGTTTACTGTCC	180
44	RM536	TCTCTCCTCTTGTGTTGGCTC	ACACACCAACACGACCACAC	160
45	RM287	TTCCCTGTTAAGAGAGAAATC	GTGTATTTGGTGAAAGCAAC	150
46	RM144	TGCCCTGGCGAAATTTGATCC	GCTAGAGGAGATCAGATGGTAGTCATG	250
47	RM19	CAAAAACAGAGCAGATGAC	CTCAAGATGGACGCCAAGA	260
48	RM277	CGGTCAAATCATCACCTGAC	CAAGGCTTGCAAGGGAAG	150



The length of the panicle is medium. Awn are present at the tip of the panicles. The 1000 grain weight of Narendra Sona is very high due long bold grains.

The amylase content of the variety is intermediate due to which.

Grains of the variety are non-sticky on cooking. Non sticky rice varieties are preferred by the Indian consumers. Gelatinization temperature of the variety was also reported on the basis of alkali spreading value and it was found medium.

The band position of prominent markers depicted in table 2 and figure - 1 also exhibits distinct and uniqueness of this variety.

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