

Original Research Article

<https://doi.org/10.20546/ijcmas.2017.611.521>

DUS Characterization of Narendra Lahar: A New High Yielding Rice Variety

S.P. Giri*, Alok Pandey, V.N. Singh, D.K. Verma, R.M. Tripathi,
Arun Kumar Singh, M.L. Maurya and R.V. Singh

Crop Research Station, Masodha (N.D. University of Agriculture and Technology), Post –
Dabhasemer, Faizabad -224133 (U.P.), India

**Corresponding author*

ABSTRACT

Keywords

Yielding,
Uniformity,
Novelty, Varieties.

Article Info

Accepted:

31 October 2017

Available Online:

10 November 2017

Information regarding Novelty, distinctness, uniformity and stability are the basic mandates for the protection of varieties under Protection of Plant Varieties and Farmers' Rights Act (PPVFRA), 2001. A field experiment was conducted at Crop Research Station, Masodha Faizabad for DUS characterization of recently released high yielding rice variety Narendra Lahar as per the guidelines of International Union for the Protection of New Varieties of Plants (UPOV) during kharif 2015. DUS test results shows that Narendra Lahar is medium maturing, maturing, good tillering ability and semi tall rice variety posses. The basal leaf sheath colour is green in coloration while leaf anthocyanin coloration is absent in the variety. Leaf: pubescence of blade surface is very weak and colorless auricles were present in the variety. Ligule was present and green in color. The grain is long slender in shape having intermediate amylase content. Molecular characterization using SSR markers also exhibits distinctness of new variety.

Introduction

Rice is the staple food of more than 2/3rd population of the world and one of the largest cultivated cereal crops. It is also the major source of nutrition and livelihood of more than 120-150 million rural households of the country and backbone of agriculture based economy of India. At 104 million tons, it accounts for 34% of food grain production and 41% of cereal production at present. 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 (1,2,3). Achieving this target in the next few decades, without harming the environment would be a great challenge. Uttar Pradesh is the 2nd largest producer of rice in

the country just after West Bengal. Eastern part of the Uttar Pradesh is the hub of rice production and rice is grown in almost all the ecologies viz. rainfed upland, well managed irrigated and rainfed lowland due highly fertile soil of Indo – Gangetic plain. The major factors affecting rice productivity in this region is low coverage by ecosystem specific varieties/hybrids, degrading soil fertility/health, erratic monsoon rainfall, shortage of labours and timely supply of other inputs. Development of new rice variety specific to prevalent ecology and agro climatic conditions is one of the options to enhanced the productivity of this region (4,5). In view of the above observation Narendra

Lahar (NDR 370135) a new high yielding rice variety was developed at Crop Research Station, Masodha for favourable irrigated ecology of Uttar Pradesh. NDR 370135 was developed from triple cross of IR 68068-99-1-3-3-3/Janak//IRRI 105. This entry was tested in Regional Agriculture Demonstration & Testing Station, Uttar Pradesh (RATDS) for consecutively three years from 20011-2014. The performance of NDR 370135 is promising in all the zones viz. central, eastern, Northern and western zones of Uttar Pradesh (6,7,8). This variety was found resistant to major location specific pests viz. Stem borer and Leaf folder and also found moderately resistant to major diseases (Blast, Sheath Blight and Bacterial Leaf Blight). The head rice recovery (HRR) of Narendra Lahar was quantified 67.80%. Agronomical evaluation of NDR 370135 indicated good fertilizer responsive trait of this rice variety. The yield capacity of this variety of irrigated medium duration is 55-60 q/ha. Performance of the NDR 370135 in On –Farm and Front Line Demonstrations was also very encouraging and it out yielded popular rice varieties of area in yield. NDR 370135 also 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 Lahar (NDR 370135) were studied for DUS characterization of the variety.

Materials and Methods

DUS characterization of Narendra Lahar

The DUS characterization of the Narendra Lahar (NDR 370135) was carried out at Crop Research Station, Masodha, Faizabad during

kharif 2015. 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 P₂O₅ is 24 kg/ha and available K₂O 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 Variety as per the national guidelines for DUS test in rice (Table 1).

Molecular characterization of Narendra Lahar

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 ilTaq DNA polymerase (5U/il) (Biotools), 1 il of genomic DNA 10 ng/il, 1 il of 10X buffer (Biotools), 0.5 il of dNTPs (2.5 mM) and 1il of each primer pair in a total volume of 10 il.

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 and figure 1.

Table.1 DUS characteristics of Narendra Lahar (NDR 370135)

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	1
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	3
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
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	1
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

S.No.	Characteristics	States	Note	Stage of observation	Type of assessment
18	Culm: attitude (for floating rice only)	Non procumbent Procumbent	1 9	Vegetative growth	1
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 Strong Very strong	1 3 5 7 9	Reproductive stage	1
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	5
30 (*)	Stem: anthocyanin colouration of nodes	Absent Present	1 9	Maturity	1

S.No.	Characteristics	States	Note	Stage of observation	Type of assessment
31	Stem : intensity of anthocyanin colouration of nodes	Weak Medium Strong	3 5 7	Maturity	
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	5
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 Purple Black	1 2 3 4 5 6 7 8 9 10	Maturity	1
39 (*	Panicle : awns	Absent Present	1 9	Maturity	1
40 (*	Panicle: colour of awns (late observation)	Yellowish white Yellowish brown Brown Reddish brown Light red Red Light purple Purple Black	1 2 3 4 5 6 7 8 9	Maturity	-
41	Panicle: length of longest awn	Very short Short Medium Long	1 3 5 7	Maturity	-

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

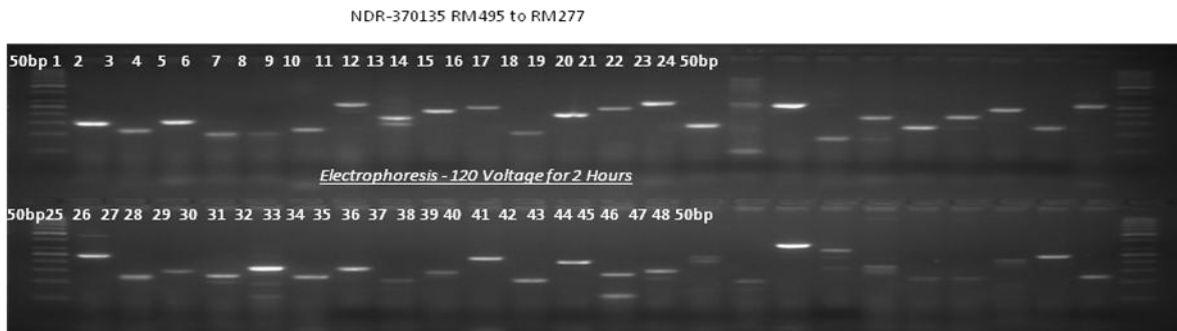
S.No.	Characteristics	States	Note	Stage of observation	Type of assessment
55 (* (+)	Decorticated grain: width	Narrow (<2.0 mm) Medium (2.0-2.5 mm) Broad (>2.5 mm)	3 5 7	Maturity	5
56. (* (+)	Decorticated grain: shape (in lateral view)	Short slender Short bold Medium slender Long slender Long bold Extra long slender	1 2 3 4 5 6	Maturity	4
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	5
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 Band position of prominent markers in Narendra Lahar

SN.	Markers	Forward Sequence	Reverse Sequence	bp
1	RM495	AATCCAAGGTGCAGAGATGG	CAACGATGACGAACACAACC	140
2	RM1	GCGAAAACACAATGCAAAAA	GCGTTGGTTGGACCTGAC	110
3	RM283	GGCATGAGAGTCTGTGATGTTGG	TAGTACTGCTCCATCTGCCTTGG	160
4	RM259	TGGAGTTTGAGAGGAGGG	CTTGTTCATGGTGCCATGT	100
5	RM312	GTATGCATATTTGATAAGAG	AAGTCACCGAGTTTACCTTC	100
6	RM5	TGCAACTTCTAGCTGCTCGA	GCATCCGATCTTGATGGG	110
7	RM431	GCTTGCTTGTATCTGCATTGGTAGG	GGGATGATCCACTCTCTGTTTGG	260
8	RM154	GACGGTGACGCACTTTATGAACC	CGATCTGCGAGAAACCCTCTCC	170
9	RM452	CTGATCGAGAGCGTTAAGGG	GGGATCAAACCACGTTTCTG	230

SN.	Markers	Forward Sequence	Reverse Sequence	bp
10	RM489	ACTTGAGACGATCGGACACC	TCACCCATGGATGTTGTCAG	250
11	OSR-13	CATTTGTGCGTCACGGAGTA	AGCCACAGCGCCCATCTCTC	100
12	RM338	CACAGGAGCAGGAGAAGAGC	GGCAAACCGATCACTCAGTC	200
13	RM55	CCGTCGCCGTAGTAGAGAAG	TCCCGGTTATTTAAGGCG	250
14	RM514	AGATTGATCTCCCATTCCCC	CACGAGCATATTACTAGTGG	280
15	RM307	GTACTIONGACCTACCGTTCAC	CTGCTATGCATGAACTGCTC	150
16	RM124	ATCGTCTGCGTTGCGGCTGCTG	CATGGATCACCGAGCTCCCCCC	300
17	RM507	TGCCCATGTATGTGAGGTACTCC	GCCTAATCCAGGACAAGCTACGG	300
18	RM413	CCAATCTTGTCTTCCGGATCTTGC	AGATAGCCATGGGCGATTCTTGG	90
19	RM161	TGCAGATGAGAAGCGGCGCCTC	TGTGTCATCAGACGGCGCTCCG	200
20	RM178	TCGCGTGAAAGATAAGCGGCGC	GATCACCGTTCCTCCGCTGC	140
21	RM334	GTTCACTGTTCACTGCCACC	GACTTTGATCTTTGGTGGACG	200
22	RM133	TTGGATTGTTTTGCTGGCTCGC	GGAACACGGGGTCGGAAGCGAC	250
23	RM510	AACCGGATTAGTTTCTCGCC	TGAGGACGACGAGCAGATTC	150
24	RM454	CTCAAGCTTAGCTGCTGCTG	GTGATCAGTGCACCATAGCG	300
25	RM162	GCCAGCAAACCAGGGATCCGG	CAAGGTCTTGTGCGGCTTGCGG	250
26	RM125	ATCAGCAGCCATGGCAGCGACC	AGGGGATCATGTGCCGAAGGCC	110
27	RM11	TCTCCTCTTCCCCGATC	ATAGCGGGCGAGGCTTAG	150
28	RM455	CCACAAATTAATCCGGATCACACC	AGCATTGTGCAATCACGAGAAGG	120
29	RM118	CCAATCGGAGCCACCGGAGAGC	CACATCCTCCAGCGACGCCGAG	150
30	RM408	CAACGAGCTAACTTCCGTCC	ACTGCTACTTGGGTAGCTGACC	120
31	RM152	GAAACCACCACACCTCACCG	CCGTAGACCTTCTTGAAGTAG	150
32	RM44	ACGGGCAATCCGAACAACC	TCGGGAAAACCTACCCTACC	110
33	RM284	ACTGCATGATCCTCCTCAGATCC	CCCTCTGATCTCTGATACTCCATCC	140
34	RM433	TGCGCTGAACTAAACACAGC	AGACAAACCTGGCCATTCAC	250
35	RM447	CCCTTGCTGTCTCCTCTC	ACGGGCTTCTTCTCCTTCTC	110
36	RM316	CTAGTTGGGCATACGATGGC	ACGCTTATATGTTACGTCAAC	230
37	RM105	GTCGTCGACCCATCGGAGCCAC	TGGTCGAGGTGGGGATCGGGTC	130
38	RM215	CAAATGGAGCAGCAAGAGC	TGAGCACCTCCTTCTCTGTAG	150
39	RM474	AAGATGTACGGGTGGCATTTC	TATGAGCTGGTGAGCAATGG	250
40	RM271	TCAGATCTACAATTCCATCC	TCGGTGAGACCTAGAGAGCC	110
41	RM171	AACGCGAGGACACGTACTTAC	ACGAGATACGTACGCCTTTG	320
42	RM484	TCTCCCTCCTCACCATTGTC	TGCTGCCCTCTCTCTCTCTC	300
43	RM552	CGCAGTTGTGGATTTCACTG	TGCTCAACGTTTACTGTCC	180
44	RM536	TCTCTCCTCTTGTTTGGCTC	ACACACCAACACGACCACAC	120
45	RM287	TTCCCTGTTAAGAGAGAAATC	GTGTATTTGGTGAAAGCAAC	120
46	RM144	TGCCCTGGCGCAAATTTGATCC	GCTAGAGGAGATCAGATGGTAGTCATG	250
47	RM19	CAAAAACAGAGCAGATGAC	CTCAAGATGGACGCCAAGA	260
48	RM277	CGGTCAAATCATCACCTGAC	CAAGGCTTGCAAGGGAAG	140

Fig.1 Major Markers and Band positions in Narendra Lahar (NDR 370135)



Results and Discussion

The data depicted in table 1 exhibit that Narendra Lahar posse's distinct, unique and stable morphological trait which differ it from the other high yielding varieties of irrigated ecosystem and land races. DUS test evaluation revealed that Narendra Lahar is medium maturing, maturing, good tillering ability and semi tall rice variety. The basal leaf sheath colour is green in coloration while leaf: anthocynin coloration is absent in the variety. Leaf: pubescence of blade surface is very week and colorless auricles were present in the variety. Ligule was present and green in color. The anthocynin coloration of nodes and internodes is absent. It possesses aweless and well exerted panicle. The length of the panicle is medium. The 1000 grain weight of Narendra Lahar is medium and shape of grain is long slender.. It possesses good cooking quality with moderate amylose content 21.56% having soft gel (Gel consistency - 46 mm). Cooked rice of Narendra Lahar is 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 SSR markers depicted in table 2 and figure 1 also exhibits distinct and uniqueness of this variety. These SSR markers were used by Shakil *et al.*, (2015) for molecular characterization of modern high yielding rice varieties of Bangladesh. The present study of molecular and morphological characterization

of Narendra Lahar will be helpful in the identification of variety and to maintain its genetic purity. This information will be very useful for the persons involved in seed certification and seed production programme.

Acknowledgement

The authors would like to thanks Dr. T. Ram, Principal Scientist (Plant Breeding), IIRR, Hyderabad for providing DNA fingerprinting facility.

References

1. Anonymous. 2001. Protection of Plant Varieties and Farmers Right Act (No. 53 of 2001). Dept. of Agriculture and Cooperation Ministry of Agriculture, Govt. of India, Krishi Bhawan, New Delhi.
2. Chakravorty, A., Ghosh, P. D. 2012. Characterization of Landraces of rice following DUS guidelines. *Research in Plant Biology* 2(6): 30-40.
3. Chakrabarty, S. K., Monika A. Joshi, Yogendra Singh, Aniruddha Maity, Veena Vashisht and Dadlani, M. 2012. Characterization and evaluation of variability in farmers' varieties of rice from West Bengal. *Indian journal of Genetics and Plant Breeding* 72(2): 136-142.
4. Chang TT, Bardenas EA, 1965. The Morphology and Varietal Characteristics

- of the Rice Plant. Tech Bull 4, IRRI, Philippines, pp40.
5. Khush, G. S. 1997. Origin, dispersal and variation of rice. *Pl. Mol. Biol.* 35: 25-34.
 6. Kwon Y.S., Lee J.M., Yi G.-B., (2005) Use of SSR markers to complement tests of distinctiveness, uniformity, and stability (DUS) of pepper (*Capsicum annuum* L.) varieties, *Molecules and Cells*, 19 (3), 428–435.
 7. Hien NL, Sarhadi WA, Oikawa Y, Hirata Y. 2007. Genetic diversity of morphological responses and the relationships among Asia aromatic rice (*Oryza sativa*) cultivars. *Jpn. Soc.Trop. Ecol.* 16: 343-355
 8. Hien NL, Yoshihashi T, Sarhadi WA, Hirata Y. 2006. Sensory test for aroma and quantitative analysis of 2-acetyl- 1-pyrroline in Asian aromatic rice varieties. *Plant Prod. Sci.* 9: 294-297
 9. INGER – IRRI (1996). Standard Evaluation System for rice. 4th ed. IRRI, p. 52.
 10. International Rice Research Institute [IRRI]. 1980. Descriptors for Rice *Oryza sativa* L. The International Rice Research Institute, Manila, Philippines.
 11. Patra, B.C. 2000. Collection and characterization of rice genetic resources from Keonjhar district of Orissa. *Oryza* 34: 324-326.
 12. PPV and FRA. 2007. Guidelines for the conduct of test for DUS on rice (*Oryza sativa* L.). Protection of Plant Varieties and Farmer's Right Authority (PPV&FRA). Government of India, New Delhi.
 13. Raut, V.M. 2003. Qualitative genetics of soyabean review. *Soybean Research* 1:1-28.
 14. Roy, JK., De, RN., Ghoari, D.P., Panda, A. 1985. Collection and evaluation of genetic resources of rice in India. *Phyrtobreedon* 1: 1-9.
 15. Shobha Rani, N, Shobha Rao, L V, Viraktamath, B.C., Mishra B. 2004. National Guideline for the Conduct of test for Distinctiveness, Uniformity and Stability. Directorate of Rice Research: 6-13.
 16. Singh Y., Singh, U.S. 2008. Genetic diversity analysis rice germplasm using agro-morphological traits. *Journal of Plant Genetic Resources* 21.(1): 32-37.
 17. Song, Q.J., Quigley, C.V., Nelson, R.L., Carter, T.E., Boerma, H.R., Strachan J.L., Crega, P.B. 1999. A selected set of trinucleotide simple sequence repeat markers for soyabean cultivar identification. *Plant Variety Seed* 12: 207-220.
 18. Subba Rao, L.V., Shiva Prasad, G., Chiranjivi, M., Chaitanyam U., Surendhar, R. (2013) DUS characterization for farmer's varieties of rice. *IOSR Journal of Agriculture and Veterinary Science* PP 35-43.
 19. Venkatesan K., BHAT K.V. (2015) Microsatellite Marker-Based Molecular Characterization of Small and Medium-Grained Aromatic Rice Germplasm of Odisha, India, *SABRAO Journal of Breeding and Genetics*, 47 (3): 248-259.
 20. Shakil S.K., Sultana S., Hassan M.M., Hossain M.M., Ali M.S., Prodhan S.H. (2015) SSR Marker Based Genetic Diversity Analysis of Modern Rice Varieties and Coastal Land Races in Bangladesh, *Indian Journal of Biotechnology*, 14 (January, 2015): 33-41.

How to cite this article:

Giri, S.P., Alok Pandey, V.N. Singh, D.K. Verma, R.M. Tripathi, Arun Kumar Singh, M.L. Maurya and Singh, R.V. 2017. DUS Characterization of Narendra Lahar: A New High Yielding Rice Variety. *Int.J.Curr.Microbiol.App.Sci.* 6(11): 5444-5453.
doi: <https://doi.org/10.20546/ijcmas.2017.611.521>