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Research Article

Elite rice variety 'VL *Dhan* 159' for cultivation under organic condition of Uttarakhand hills

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Abstract
VL *Dhan* 159 is an early duration rice variety suitable for cultivation under rainfed upland organic condition of Uttarakhand hills. This variety has been developed by ICAR-*Vivekananda Parvatiya Krishi Anusandhan Sansthan*(VPKAS) Almora, Uttarakhand for the *kharif* season and released by the State Varietal Release Committee of Uttarakhand in 2020, Subsequently it was notified by the Central Seed Committee vide notification number S.O.500(E) dated the 29th January, 2021. VL *Dhan* 159 is derived from the cross VL 66/HPR 2143 with a maturity duration of 110-115 days. Under organic conditions, this variety has recorded an average yield of 2,054 kg/ha and out yielded the check varieties of *Vivek Dhan* 154 by 42.34 per cent, VL *Dhan* 221 by 27.34 per cent and VL *Dhan* 156 by 33.64 per cent. It was found resistant against leaf and neck blast (score 0-3), brown leaf spot (score 3-4), sheath rot (score 1), leaf scald (score 1-3), false smut (score 0), stem borer and leaf folder (score 0-1) under natural condition. It has more number of panicles/ m^2 (229) compared to the checks of *Vivek Dhan* 154 (200) and VL *Dhan* 156 (172). This variety has non lodging intermediate plant height, semi-erect with well exerted panicle. It has exhibited a better quality characteristics like high hulling (82.8%) and milling (72.1%), intermediate Alkali Spreading Value (4.0), Gel consistency (50) and amylose content (25.93%). Grain Chalkiness is very occasionally present. It has short bold grain with L/B ratio of 2.00

Key words
VL *Dhan* 159, organic condition, Rainfed upland, hill rice, early duration, high yielding variety

INTRODUCTION

Rice is the major *kharif* crop of Uttarakhand cultivated in about 2.56 l. ha area with a production of 6.17 l. t. and productivity of 2,412 kg/ha (DES, 2018). A huge difference in production and productivity of rice between hill and plain region is observed mainly due to the availability of irrigation facilities and improved varieties. Rice grown in plains are almost entirely under irrigated condition whereas about 67 per cent area in hill rice is under rainfed condition, therefore, the development of improved varieties of rice for rainfed upland ecosystem is essential for yield stabilization for hill farmers and fulfill the requirement of rainfed upland rice growers.

Traditionally, upland rice is grown during the spring season locally known as *Chaiti or Chetki Dhan* or Spring sown rice in English in hill region of Uttarakhand and its cultivation is being practiced under two years of crop rotation *i.e.,* Spring rice (sown in March end/April and harvested by September end /Oct start)-Wheat (October to May)-Finger/ Barnyard millet (June to September)-Fallow (October to / March) which allows harvesting of only three crops in two years period with a cropping intensity of 150 per cent only. Keeping this point in view, concerted efforts have been made for the development of high yielding, early duration varieties of rice for upland hill regions in order to increase the cropping intensity 200 per cent (i.e., two crops/year) by sowing upland rice in the month of June and harvest in the month of October.

VL *Dhan* 159 is an early duration rice variety suitable for

cultivation under rainfed upland ecosystem of Uttarakhand hills under organic condition. This has been developed by ICAR-*Vivekananda Parvatiya Krishi Anusandhan Sansthan* (VPKAS), Almora, Uttarakhand for *kharif* season and has been released by the State Varietal Release Committee of Uttarakhand in 2020 and recently notified by the Central Seed Committee vide notification number S.O.500(E) dated the 29th January, 2021. The cultivation of this variety not only increases cropping intensity owing to its short duration but also significant impact on production and productivity of rainfed upland rice. This newly developed variety matures in 115-120 days and can be sown after onset of monsoon and harvested before the successive *Rabi* season crop.

MATERIALS AND METHODS

VL *Dhan* 159 is derived from a cross between VL 66 and HPR 2143 developed at ICAR-*Vivekananda Parvatiya Krishi Anusandhan Sansthan* Almora, Uttarakhand. The cross was made in 2007 and F_1 seeds were evaluated in 2008. The F_2 seeds were raised in 33 rows in 2009 and ears were selected from the four best plants based on high yielding ability, intermediate plant type, disease resistance and other desirable traits and harvested separately. Each F_3 ears were grown in 2 rows in 2010. The pedigree method was followed for generation advancement up to F_6 generation. Four progenies of this cross were evaluated in observational nursery in 2013 and the best progeny rows namely; VR 2929-2 found significantly superior to the best check was bulked for further evaluation in station trial. It was named as VL 20083 in station trial and tested for two years during 2014 and 2015 for yield and disease resistance. Based on its excellent performance in station trial over the best check, it was nominated as entry in State Variety Trial (SVT) in 2016 and further evaluated under multilocation rainfed upland hill trials for three years (2016-2018) of SVT centers of Uttarakhand state. The experiment was conducted in randomized complete block design (RCBD) in three replications and observations were recorded in each replication for grain yield (kg), days to 50% flowering, days to maturity, plant height (cm), panicle length (cm) and panicle per meter square. The entry, VL 20083 was found significantly superior over the checks for three years under SVT, therefore, identified for release as a variety and finally, it was released in 2020 and notified in the subsequent year 2021 as VL *Dhan* 159.

The reactions to the major diseases and insect pests under natural condition in SVT during 2016-2018 and in AICRP Trials during 2017-2018 under both natural and artificial condition were recorded. Grain quality characteristics were analyzed at ICAR- Indian Institute of Rice Research, Hyderabad in 2018. The agronomic performance of the variety was evaluated in 2020.

RESULTS AND DISCUSSION

VL *Dhan* 159 is a June sown rainfed upland rice genotype suitable for hills and valleys of Uttarakhand. It has shown overall mean grain yield 2,054 kg/ha over three years (2016-2018) in multilocation testing under SVT and out yielded the checks, *Vivek Dhan* 154 by 42.34 per cent, VL *Dhan* 221 by 27.34 per cent and VL *Dhan* 156 by 33.64 per cent (**Table1**).

The data regarding performance of the variety in agronomic trial is presented in **Table 2.** This variety was found responsive at both lower and normal fertility level and overall recorded significantly higher grain yield (2,353 kg/ha) over the best check VL *Dhan* 156 (2,117 kg/ha).

This variety has shown resistance against major diseases *viz*., leaf and neck blast (score 0-3), brown leaf spot (score 3-4), sheath rot (score 1), leaf scald (score 1-3) false smut (score 0) (**Tables 3-4**) and insect pests *viz*., stem borer and leaf folder (score 0-1) evaluated under natural as well as artificial conditions (**Tables 5-6**).

Table 1. Summary of grain yield data of State Varietal Trials

	Year of testing	Name of trial (location)	Proposed variety (VL 20083)	Check Var. 1 (*Vivek Dhan* 154)	Check Var. 2 (VL *Dhan* 221)	Check Var. 3 (VL *Dhan* 156)
Mean yield (kg/ha)	2016	SVT(4)	2,555	1,780	1,613	-
	2017	SVT(4)	2,187	1,605	-	1,942
	2018	SVT(4)	1,420	943	-	1,131
Weighted Mean			2,054	1,443	1,613	1,537
Percentage increase over the checks	2016	SVT	-	(+) 43.54	(+) 58.40	-
	2017	SVT	-	(+) 36.26	-	(+) 12.62
	2018	SVT	-	(+) 50.58	-	(+) 25.55
Mean percentage increase				(+) 42.34	(+) 27.34	(+) 33.64
Frequency in the top group (pooled for 3 years)			6/12	1/12	0/12	2/12

Table 2. Adaptability to changes in agronomic conditions in Uttarakhand Hills, Almora during *Kharif*, 2020

Experiment	Year of testing	Item	Proposed variety VL *Dhan* 159	Check Var.1 (Vivek *Dhan* 154)	Check Var.2 (VL *Dhan* 156)
			Grain yield (kg/ha)		
Fertilizer Experiment response to NPK(Recommended dose of fertilizer 60:30:20 kg/ha)	2020	F1: 50 % RDF	2030	1692	1969
		F2: 100 % RDF	2676	2126	2264
		Mean	**2353**	**1909**	**2117**

Table 3. Reaction to major diseases under natural condition in SVT during *Kharif*, 2016-18 (Maximum Score on scale 0-9)

Disease	Year	Proposed variety (VL 20083)	Check Var. 1 (*Vivek Dhan* 154)	Check Var. 2 (VL *Dhan* 221)	Check Var. 3 (VL *Dhan* 156)
Leaf Blast	2016	3	1	3	-
	2017	3	1	-	1
	2018	3	3	-	3
	Mean	**3.0**	**1.7**	**3.0**	**2.0**
Neck Blast	2016	0	5	3	-
	2017	3	5	-	3
	2018	1	1	-	1
	Mean	**1.3**	**3.7**	**3.0**	**2.0**
Sheath Rot	2016	1	1	1	-
	2017	1	1	-	1
	2018	1	1	-	1
	Mean	**1.0**	**1.0**	**1.0**	**1.0**
Brown Leaf Spot	2016	3	1	3	-
	2017	4	3	-	3
	2018	4	4	-	4
	Mean	**3.7**	**2.7**	**3.0**	**3.5**
Leaf Scald	2016	1	3	3	-
	2017	3	5	-	3
	2018	1	5	-	5
	Mean	**1.7**	**4.3**	**3.0**	**4.0**
False Smut	2016	0	1	0	-
	2017	0	0	-	0
	2018	0	0	-	0
	Mean	**0.0**	**0.3**	**0.0**	**0.0**
Grain Discolouration	2016	3	3	1	-
	2017	1	1	-	1
	2018	1	1	-	1
	Mean	**1.7**	**1.7**	**1.0**	**1.0**

This variety has very good and acceptable grain qualities *viz*., hulling 82 per cent; milling 72 per cent; kernel length 5.27mm; kernel breadth 2.63mm; L/B ratio 2.00mm short bold grain. It has exhibited an intermediate alkali spread value (4.0), gel consistency (50mm) and amylose (25.93%) content (**Table 7**).

It has short bold grain with plant height of 95-105 cm

Table 4. Reaction to major diseases in All India Coordinated Trials during *Kharif,* 2017 & 2018

Parameter	Year of testing	No. of Location	Proposed variety VL Dhan 159	Check Var.1 *Sukradhan* 1 (NC)	Check Var.2 *Vivek Dhan* 154 (RC)
Leaf Blast (SI)	I Year (2017)	8	6.1	5.4	6.0
	II Year (2018)	10	5.6	5.1	4.9
	Mean		**5.9**	**5.3**	**5.5**
Neck Blast (SI)	I Year (2017)	9	4.2	5.4	6.2
	II Year (2018)	9	4.6	5.0	6.2
	Mean		**4.4**	**5.2**	**6.2**
Brown Spot (SI)	I Year (2017)	5	5.4	4.8	6.6
	II Year (2018)	5	5.6	5.4	5.6
	Mean		**5.5**	**5.1**	**6.1**
Rice Tungro Disease (SI)	I Year (2017)	1	3.0	5.0	5.0
	II Year (2018)	2	4.0	6.0	7.0
	Mean		**3.5**	**5.5**	**6.0**

Table 5. Reaction to major insect pests under natural condition in SVT during *Kharif*, 2016-18 (Maximum Score on scale 0-9)

Insects	Year	Proposed variety (VL 20083)	Check Var. 1 (*Vivek Dhan* 154)	Check Var. 2 (VL *Dhan* 221)	Check Var. 3 (VL *Dhan* 156)
Stem borer	2016	0	0	0	-
	2017	1	0	-	0
	2018	0	0	-	0
	Mean	**0.3**	**0.0**	**0.0**	**0.0**
Leaf folder	2016	1	1	1	-
	2017	0	0	-	1
	2018	1	0	-	1
	Mean	**0.7**	**0.3**	**1.0**	**1.0**

Table 6. Reaction to major insect pests in All India Coordinated Trials during *Kharif,* 2017 & 2018

Parameter	Year of testing	No. of Location	Proposed variety VL Dhan 159	Check Var.1 *Sukradhan* 1 (NC)	Check Var.2 *Vivek Dhan* 154 (RC)
BPH (GR, DS)	I Year (2017)	4	8.8	7.5	7.1
	II Year (2018)	4	7.7	7.1	8.3
	Mean		**8.3**	**7.3**	**7.7**
WBPH (GR, DS)	I Year (2017)	2	8.0	7.0	6.4
	II Year (2018)	2	7.8	7.8	7.4
	Mean		**7.9**	**7.4**	**6.9**
Stem Borer White Ear (% WE)	I Year (2017)	2	12.6	7.1	25.6
	II Year (2018)	1	26.1	19.7	14.6
	Mean		**19.3**	**13.4**	**20.1**
Leaf Folder (% DL)	I Year (2017)	0	NA	NA	NA
	II Year (2018)	2	15.2	28.6	23.3
	Mean		**15.2**	**28.6**	**23.3**
Grass Hopper (% DL)	I Year (2017)	1	13.5	11.2	12.9
	II Year (2018)	1	12.5	14.3	12.9
	Mean		**13.0**	**12.8**	**12.9**

Table 7. Data on grain quality characteristics of the variety VL *Dhan* 159

Grain quality characteristics	Proposed variety VL Dhan 159	Check Var.1 *Sukradhan* 1 (NC)	Check Var.2 *Vivek Dhan* 154 (RC)	Check Var.3 (LC)
Hulling (%)	82.8	80.2	76.6	73.5
Milling (%)	72.1	71.4	61.0	46.2
Kernel length(mm)	5.27	6.94	6.54	6.88
Kernel breadth (mm)	2.63	2.03	2.35	2.18
L/B ratio	2.00	3.41	2.78	3.06
Grain type	SB	LS	LB	LS
Grain Chalkiness	VOC	VOC	VOC	VOC
Alkali Spreading Value	4	4	4	4
Amylose content (%)	25.93	24.46	26.75	28.04
Gel Consistency (mm)	50	49	25	22

Table 8. Morphological Description of VL *Dhan* 159 (VL 20083) as per DUS guidelines

S. No.	Characters and code	Expression and score
1.	Basal Leaf: Sheath colour	Green (1)
2.	Leaf: Pubescence of blade surface	Absent (1)
3.	Leaf: Auricles	Present (9)
4.	Leaf: Anthocyanin colouration of auricles	Colourless (1)
5.	Leaf: Shape of ligule	Split (3)
6.	Leaf: Colour of ligule	White (1)
7.	Flag leaf: Attitude of blade (early observation)	Erect (1)
8.	Fag Leaf: Attitude of blade (late observation)	Erect (1)
9.	Time of heading (50 % of plant with panicles)	Early (3)
10.	Lemma: Anthocyanin colouration of apex	Absent (1)
11.	Spikelet: Colour of stigma	White (1)
12.	Stem: Length (excluding panicle; excluding floating rice)	Very Short (1)
13.	Stem: Anthocyanin colouration of nodes	Absent (1)
14.	Panicle: Length of main axis	Medium (5)
15.	Panicle: Curvature of main axis	Semi-straight (3)
16.	Spikelet: Density of pubescence of lemma	Absent (1)
17.	Spikelet: Colour of tip of lemma	White (1)
18.	Panicle: Awns	Absent (1)
19.	Panicle: Colour of awns (late observation)	Not Applicable
20.	Panicle: Distribution of awns	Not Applicable
21.	Panicle: Attitude of branches	Semi erect (5)
22.	Panicle: Exertion	Well exerted (7)
23.	Sterile lemma: Colour	Straw (1)
24.	Decorticated grain: Length	Short (1)
25.	Decorticated grain: Width	Medium (5)
26.	Decorticated grain: Shape (in lateral view)	Short Bold (2)
27.	Decorticated grain: Colour	White (1)
28.	Endosperm: Content of amylose	Medium (5)
29.	Decorticated grain: Aroma	Absent (1)

and panicle length of 20-23cm. It has more number of panicles/m^2 (229) in comparison to checks *Vivek Dhan* 154 (200) and VL *Dhan* 156 (172). It possesses semi-erect, intermediate and non-lodging plant type, green coloured leaf blade and leaf sheath, and and erect flag leaf compact and well exerted panicle, awless grains and straw apiculus colour (**Table 8**).

The seed production of this variety is normal in hill region as per standard procedure and doesn't require any specific attention. However, if locations in plains are selected, care should be taken for the soil and climatic conditions for potential production.

This new variety fulfills the requirement of rainfed upland rice growers and has potential to increase the production and productivity of upland rice in hill regions of Uttarakhand.

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