

Widening the malt barley cultivation in north western plains of India

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Abstract

DWRB73 and DWRUB 64, both are early maturing malt barley varieties with duration of 113 days (110-118 days) and 116 days (116-117 days), respectively. In malting quality analysis, DWRB 73 has shown good overall quality score (15/27) comparable to the best check DWRUB 52 (16/27) and superior to checks viz. RD 2668 (13/27) and K 551 (12/27). DWRUB 64 had better hectiolitre weight (59.20 kg), proportion of bold grains (87.5 %), hot water extract (77.1 % db), malt yield (88.9 %) and wort filtration rate (210.5 ml/hr) over the six-rowed check K 551, under late sown conditions.

Key words: Malt barley, public private partnership, quality improvement

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Introduction

Barley (*Hordeum vulgare* L.) is one of the earliest domesticated cereals (Pourkheirandish and Komatsuda 2007). It is the fourth most important cereal crop in the world after wheat, maize and rice and used for animal feed, malting and brewing and human food (Pal *et al.* 2012). With the growing urbanization, open economy and changing lifestyles demand for quality malt and malt products has increased in last two decades in India. Malt is being utilized for brewing, distillation, baby foods, confectionaries, cocoa-malt drinks and medicinal syrups with the major share going to brewing in India as well as globally (Verma *et al.* 2011). Among cereals, barley is most preferred for malt, because its husk protects the coleoptile (acrosipire) during germination process and provides aid in filtration, firm texture of grains faster uptake of moisture during steeping. Its higher amylase activity makes it unique amongst common cereals for malt recovery. It also has immense potential as quality cereal especially for nutritional and medicinal point of view (Cavallero *et al.* 2002, Qureshi *et al.* 1991).

Barley cultivation for malting purposes is mostly confined to the north western plains in India, with assured irrigation to get optimum grain yield and quality. Rajasthan, western Uttar Pradesh, Haryana and Punjab states provide good quality barley for malting. The industrial use (20-25%) of barley is for malting purposes in India, while the rest is utilized as feed grain and very little quantity is utilized as food. The annual requirement of barley for malting purposes is on continuous rise in recent years. In order to meet the required barley quantity as good quality raw material for their annual consumption, many of the private companies have initiated "Contract Farming" in different

states with the new two-row cultivars released as malt type barley. In addition, a few of them have also initiated the Research and Development (R & D) activities for varietal improvement and agronomic practices. Public private partnership is a new dimension to carry out research and development in agricultural sector. The partnership stimulates innovation for agricultural development and promotes the researchers capacity. Malt barley cultivars have been developed for north western plains by such partnership, which have been utilized for commercial cultivation by different companies.

Materials and methods

During past few years it has been experienced that malt barley cultivation has to face stiff competition during *rabi* season with wheat under timely sown conditions, in terms of yield and economy, especially in rice-wheat cropping system. However, under some areas of Rajasthan, Haryana, Punjab etc. where *rabi* sowings are delayed due to late harvest of crops like cotton, sugarcane, sorghum and pearl millet, wheat is not performing well. It was perceived that such areas can be put under malt barley cultivation by farmers and private companies with better technologies. Further, adoption of new climate resilient technologies, better agronomic practices and crop protection technologies can help farmers for better production and remunerative. This exercise has resulted in development of, two short duration varieties viz. DWRB 73 (two-row type malt barley) and DWRUB 64 (six-row type), which were subsequently released and notified by the "Central Sub-Committee on Crop Standards Release and Notification" (CVRC) in 2011 and 2012, respectively for irrigated late sown conditions of North Western Plains Zone (NWPZ). These varieties can be fitted well in potential areas of barley cultivation under late sown conditions in different states in zone under different crop

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rotations. The variety DWRUB 64 has been developed under a collaborative project with M/S United Breweries Ltd. Bangalore and is a fine example of public-private partnership in barley crop.

Results and discussion

DWRB 73 (PL710 / DWR17) was tested at a total of 25 locations with three checks viz. RD 2668 and DWRUB 52 (both two row) and K 551 (six row) under the AICW&BIP from 2007-08 to 2009-10 crop seasons (Anonymous, 2008, Anonymous, 2009, Anonymous, 2010). DWRB 73 exhibited average grain yield as 3871 Kg ha⁻¹ (mean of 25 trials over 3 years). It was superior in grain yield on three years mean basis and as well as on individual year basis over zonal checks DWRUB 52 (4.85%), RD 2668 (6.04%) and six-row check K 551 (3.75%). The variety was significantly superior to all checks in the 3rd year evaluation (Table 1). In agronomical trials also, DWRB 73

has shown significant superiority in grain yield over checks DWRUB 52 (5.2%), RD 2668 (10.9%) and K 551 (17.3%) at recommended dose of fertilizers under multilocation evaluation (Anonymous 2010).

Similarly, DWRUB 64 (DL 472 / PL 705) was tested at a total of 28 locations (first year 5, second year 6, third year 9 and fourth year 8 locations) with three checks viz. DWRB 73 and DWRUB 52 (both two row) and K 551 (six row). DWRUB 64 exhibited average grain yield as 4050 Kg ha⁻¹ (mean of 28 trials over 4 years) (Anonymous 2006, Anonymous 2007, Anonymous 2008, Anonymous 2011). It exhibited significant superiority in grain yield on four years mean basis over zonal checks K 551 (11.2%), DWRUB 52 (6.9%) and DWRB 73 (10.1%) (Table1). In agronomical trials also, DWRUB 64 has shown significant superiority in grain yield over checks DWRUB 52 (6.3%), DWRB 73 (11.9%) and K 551 (13.1%) at recommended nitrogen doses (Anonymous 2011).

Table 1. Summary yield data of coordinated varietal trials under irrigated late sown conditions for DWRB 73 and DWRUB 64

DWRB 73 (2-R)							
Mean yield (q ha ⁻¹)	Year of testing	No. of trials	DWRB 73	RD 2668 (C)	DWRUB 52 (C)	K 551 (C 6-R)	C.D.
	2007-08	7	41.6	38.6	41.1	41.2	3.0
	2008-09	11	37.0	35.3	34.9	36.3	2.86
	2009-10	7	38.5*	-	35.9	35.0	1.32
	Mean	25	38.71	36.58	36.92	37.31	
Percentage increase over the checks	Mean			+6.04	+4.85	+3.75	-
Frequency in the top group	-	25	7/25	2/18	4/25	5/25	-
DWRUB 64 (6-R)							
Mean yield (q ha ⁻¹)	Year of testing	No. of trials	DWRUB 64 (6-R)	DWRB 73 (2-R) (C)	DWRUB52 (2-R C)	K551 (6-R C)	C.D.
	2005-06	5	40.9*	-	-	33.2	1.7
	2006-07	6	40.1	-	39.7	38.8	1.1
	2007-08	9	39.5*	-	36.5	35.2	1.3
	2010-11	8	41.9*	36.8	38.3	38.1	1.3
	Mean	28	40.5	36.8	37.9	36.5	
Percentage increase or decrease over the checks		28	-	10.1	6.9	11.2	-
Frequency in the top group		28	19/28	1/8	9/23	10/28	-

*significantly superior to all checks

DWRB73 and DWRUB 64, both are short duration varieties with maturity of 113 days (110-118 days) and 116 days (116-117 days), respectively. The average plant height of DWRB 73 is 86 centimetre (82-92 cm) and DWRUB 64 is 84 centimetre (78-93 cm). Days to heading exhibited general mean value of 80 and 76 for DWRB 73 and DWRUB 64, respectively. For 1000 grain weight and numbers of tillers DWRB 73 depicted general mean value of 51 g (48-56) and 123 (105-135), while values of 42 g (40-44) and 107 (98-116) were recorded for DWRUB 64, respectively,

DWRB 73 and DWRUB 64 both are hulled type with erect type growth habit and exhibit non pigmented coleoptiles, leaf sheath and auricles and at boot stage foliage colour is green and leaf width is medium. Spikes are parallel in shape with intermediate ear density. As per as the concern of waxiness leaf sheath and peduncle are waxy in nature for both the varieties, while for DWRUB 64 flag leaf and spikes are non waxy. Awns are long and light yellow in colour. In case of DWRB 73 grains are bold, hard, semi oval and yellow in colour with whitish aleurone layer,

grain crease width is medium with short rachilla hairs, while in case of DWRUB 64 grains are of medium size and medium hard (texture), oval and yellow in colour with whitish aleurone layer, grain crease width is medium and rachilla hairs are absent.

Under artificial conditions, DWRB73 is comparable in resistance to yellow rust with checks DWRUB 52 and RD 2668 and the highest score and Average Coefficient of Reaction (ACI) were recorded as 30S (5.9), 30S (9.1) and 10S (3.6) for first, second and third years, respectively, while another check K 551 was highly susceptible to yellow rust and depicted high score as 80S (31.4). DWRB 73 is resistant to leaf rust (which is most important disease for late sown crop) under artificial conditions at both adult

plant and seedling stage, while K 551 is highly susceptible to leaf rust.

Similarly, DWRUB 64 was completely free from yellow rust at adult plant stage in first and third year of testing and was also comparable with checks in fourth year under artificial conditions. DWRUB 64 was also exhibited seedling resistance under artificial conditions and was completely free from yellow rust under natural conditions in trials. It was also tolerant to leaf rust and leaf blights under artificial as well as natural conditions and was comparable to checks. The performance of DWRUB 64 was also comparable for aphids and cereal cyst nematodes with all the checks viz. DWRUB 52, DWRB 73 and K 551.

Table 2. Three year mean performance of DWRB 73 for important malting quality traits

Variety		DWRB 73	RD 2668 (C)	DWRUB 52 (C)	K 551 (6-R)
Grain trait	Hectoliter weight (Kg hl ⁻¹)	63	63	65.7	58.3
	Proportion of bold (%)	85	59	78.3	58
	Husk (%)	10.83	9.9	10.8	12.6
	Protein (%)	12.47	12.15	11.73	11.2
Malt trait	Friability (%)	72	65.6	72.4	68.1
	Hot water extract (% db)	76.7	74.8	76.2	71.2
	Diastatic power (°L)	103	113	90	95
	Kolbach index	0.39	-	0.37	0.41
	Wort viscosity (mpas/ s)	1.64	-	1.71	1.78
Overall score (27)		15	13	16	12

In malting quality analysis, DWRB 73 has shown good overall quality score (15/27) comparable to the best check DWRUB 52 (16/27) and superior to checks viz. RD 2668 (13/27) and K 551 (12/27). On the basis of three years performance, it has specific advantages for important traits like proportion of bold grains (85 %), protein content (12.47 %), hot water extract (76.7 % db), and Kolbach index (0.39) under late sown conditions, over the checks. DWRB 73 was also comparable with checks for hectolitre weight (63 kg), friability (72 %), diastatic power (103 °L) and wort viscosity (1.64 mpas/s) (Table 2).

DWRUB 64 has shown advantage in overall quality score (70/108) than the six-row check K 551 (52/108) and two-row checks viz. DWRUB 52 (49/81) and DWRB 73 (30/54). On the basis of four years mean performance, it had better hectolitre weight (59.2 kg), proportion of bold grains (87.5 %), hot water extract (77.1 % db), malt yield (88.9 %) and wort filtration rate (210.5 ml/hr) over the six-rowed check K 551, under late sown conditions. DWRUB 64 was also comparable with the check K 551 for husk percentage (11.4 %), germinative energy (89.5 %), protein content (10.7 %), diastatic power (92.5 °L)

and sachharification rate (5.7 min.) (Table 3). Therefore, DWRUB 64 is a better six-row type barley for malting quality than six-row check K 551. In addition, most of the grain and malt trials it has shown comparable performance with two-row type checks DWRUB 52 and DWRB 73, known for better malting quality.

Cultivation of newly released varieties DWRB 73 and DWRUB 64 in NWPZ under late sown conditions would uplift socio-economic status of farmers and prove boon in sustaining their livelihood, stabilizing productivity with better returns under contract farming and as well as meeting the requirements of the quality raw material for malting and brewing industry. The availability of the better varieties for malt barley under late sown condition will also provide an option to wheat for farmers in areas other than rice-wheat crop rotation, in the states of Punjab, Haryana, western Uttar Pradesh and Rajasthan, where *rabi* sowings are delayed due to late harvest of previous *kharif* crops like cotton, sugarcane, sorghum and pearl millet etc. It will also help in increasing overall barley area and production in India under limited resources of irrigation and fertilizers.

Table 3. Four year mean performance of DWRUB 64 for important malting quality traits

Quality trait	Varieties				
	DWRUB 64	DWRB 73 (C)	DWRUB 52 (C)	K 551 (C)	
Grain traits	Hectoliter weight (Kg hl ⁻¹)	59.2	62.5	64.5	57.5
	Proportion of bold grains (%)	87.5	85	76	71.2
	Husk (%)	11.4	10.8	11.1	11.9
	Germinative energy (%)	89.5	98.5	97.3	92.8
	Protein (%)	10.7	13.1	12.2	11
Malt traits	Friability (%)	57.3	72.6	80.9	77.8
	Hot water extract (% db)	77.1	77	78.2	75.1
	Malt yield (%)	88.9	84	84.9	86.1
	Filtration rate (ml/hr)	210.5	240	205.5	207
	Diastatic power (°L)	92.5	106.5	98.3	94
	Kolbach index	0.43	0.39	0.4	0.43
	Sachharification rate (Min)	5.7	5	6	6
	Overall score (108)	70/108	30/54	49/81	52/108

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