Short Communication

Stability analysis for fruit yield and its components in *Ber* (*Ziziphus mauritiana* Lamk)

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Arid region of India is spread over 38.70 m ha covering about 12 per cent of the total area of the country. The tracts of hot arid region are found in the states of Rajasthan (19.6 m ha) followed by Gujarat (6.2 m ha), Andhra Pradesh (2.02 m ha), Punjab (1.5 m ha), Haryana (1.3 m ha) and Maharashtra (0.1 m ha) [1]. Farming being difficult in the arid tropics, the agro-climate of such regions favours the cultivation of some fruit crops. Indian jujube (*Ziziphus mauritiana* Lamk) commonly known as ber belonging to family Rhamnaceae being indigenous to India can be successfully cultivated in the hot arid region of the country. The fruits of Indian jujube are rich in vitaniin C, A, and B complex. In Punjab it is cultivated on 2,500 ha having production of 42,847 mt annually [1]. The choice of a stable cultivar is of paramount importance as a cultivar performing well in one locality may behave differently under different agro climatic conditions. The identification of a cultivar having wide adaptability is very important so that it may give stable performance. The present investigation was carried out to find out stable cultivar(s) for arid irrigated zone of Punjab.

The experimental material comprising of 9 cultivars *viz*., Gola, Muria Murhera, Sandhura Narnaul, Katha Phal, Umran, Seb, Najuk, Chhuhara and Walaiti collected from different parts of India was accommodated in randomized block design with four replications at Punjab Agricultural University, Regional Research Station, Bathinda, Punjab. Three plants of each cultivar in each replication were grown at a spacing of 7.5 x 7.5 m. Data were recorded on fruit yield per tree (kg), fruit weight (g), fruit length (cm), fruit breadth (cm), stone weight (g), total soluble solids (TSS), acidity (%), pulp % and pulp stone ratio during six years of 2001-02 to 2006-07. The data were subjected to stability analysis as per the model of Eberhart and Russel [2].

The analysis of variance for each year as well as pooled over years showed that the mean squares due to cultivars were significant for all the characters and the cultivars interacted strongly with the environment. Environment (linear) interaction component was also significant for all the traits. Significant variance due to pooled deviation (nonlinear) reflected considerable genetic diversity in the experimental material. Tomar and Singh [3] also reported significant influence of environment during different years on six *ber* cultivars grown at Bathinda. The means ($\bar{x}$), regression coefficients (b_i) and deviations from regression (S^2d_i) for fruit yield and other characters are depicted in Table 1.

Cultivars having high mean with near unity b_i and lowest S^2d_i are considered stable over environments. Cultivar Umran having high fruit yield (60.6 kg/tree) along with b_i 1.2319 and non-significant S^2d_i value is most stable over environments. This cultivar performed at Bahadurgarh (Patiala) [4] as well as at different agroclimatic regions of Pujanb and Haryana for fruit yield

Table 1. Estimates of stability parameters for different characters in *ber*

Cultivar	Fruit weight (g)			Fruit length (cm)			Fruit breadth (cm)		
	Mean	b_i	S^2d_i	Mean	b_i	S^2d_i	Mean	b_i	S^2d_i
Gola	14.59	-1.9544*	1.0528	33.8	0.0339	0.0122	29.2	1.4072	0.0050**
Muria Murhera	23.56	0.2728	3.0471*	55.6	0.6565	0.0116	29.8	1.5568	0.0063**
Sandura Narnaul	21.48	1.6751	1.5101**	50.1	2.0596*	0.0357**	29.9	-0.3048	0.0260*
Katha Phal	17.01	1.4204	0.8733	37.6	3.5577**	0.0566**	30.6	1.2313	0.0458**
Umran	27.41	0.1577	0.2846	46.5	-0.1073**	0.0010	31.7	0.6536	0.1670**
Seb	25.92	0.5646	0.2297	38.0	-0.1578**	0.0037	36.2	0.3280	0.0031*
Najuk	16.16	-0.1995**	0.6303	41.4	0.4439	0.0509**	25.8	1.3154	0.0040**
Chhuhara	16.05	6.1274*	2.7260**	36.1	1.6290	0.0089	25.0	2.0191	0.0063**
Walaiti	20.04	0.9367	2.1571**	48.8	0.7850	0.0563**	24.8	0.7942	0.0288**
Population mean	20.25	1.000		43.10			29.6		
SE(m)	0.909	1.4176	0.081	0.7685	0.09	1.2261			

Cultivar	Stone weight (g)			TSS (%)			Acidity (%)		
	Mean	b_i	S^2d_i	Mean	b_i	S^2d_i	Mean	b_i	S^2d_i
Gola	0.91	-3.0536	0.0102**	14.88	1.7470	2.0731**	0.53	1.5368	0.0232**
Muria Murhera	1.27	11.9845**	0.0466**	14.31	0.7330	0.2572**	0.32	2.8803	0.0061**
Sandura Narnaul	1.34	-3.9968	0.0941**	14.79	0.4634	0.5878**	0.31	2.3478	0.0065**
Katha Phal	1.38	1.2192	0.0103**	17.60	1.0014	0.0326**	0.79	-0.6717	0.0022**
Umran	1.10	0.1208	0.0044	15.34	0.2124**	0.5227**	0.41	0.0951**	0.0000
Seb	1.40	4.2671	0.0060*	16.47	0.1574	0.4105**	0.36	1.2119	0.0009*
Najuk	1.21	4.5891	0.0116**	18.82	1.5078	0.5965**	0.37	-1.0606	0.0034**
Chhuhara	0.79	-0.6268	0.0015	19.25	1.9917**	0.3609**	0.29	1.3499	0.0048**
Walaiti	1.15	-5.5007**	0.0427**	17.12	1.6116	0.0333**	0.44	1.3683	0.0065**
Population mean	1.18	1.000		16.51	0.9988		0.44	1.0064	
SE(m)	0.08	5.02		0.476	0.605		0.039	1.5140	

Cultivar	Pulp (%)			Pulp stone ratio			Fruit yield (kg/tree)		
	Mean	b_i	S^2d_i	Mean	b_i	S^2d_i	Mean	b_i	S^2d_i
Gola	93.71	0.1966	0.0329	14.97	-0.1568**	0.1873**	49.98	1.4808*	35.080
Muria Murhera	94.62	-0.3580	1.0101	18.01	0.6295	11.6181**	60.88	1.3376	160.202**
Sandura Narnaul	93.75	2.6696	1.9796**	15.66	0.1601	18.3279**	44.61	1.2792	93.213
Katha phal	91.85	0.9045	0.0353**	11.30	0.0822**	0.1246	37.30	1.5738*	44.3855
Umran	96.01	-0.1471	0.0594	24.24	0.1692	1.9061	60.06	1.2319	95.5781
Seb	94.68	-0.9073*	0.0875**	17.54	-0.8914**	0.6233	49.88	1.5421	268.426**
Najuk	93.10	-3.1643*	0.4404**	12.48	-0.6172*	2.1638	50.33	0.1981	146.123
Chhuhara	93.45	5.6684**	0.7661**	20.11	7.8313**	13.3816**	59.70	0.4015	217.418**
Walaiti	93.28	4.1291	0.7870**	16.88	1.7931	16.9404**	32.75	-0.0447**	38.5877
Population mean	93.99	.9990		16.80	1.000		49.44	1.000	
SE(m)	0.38	2.3681		1.3465	1.4862		5.525	0.4446	

* and **significant with respect to pooled error at 5% and 1% respectively

per tree as compared to other cultivars [5, 6]. However, yield performance of this cultivar was at par with other cultivars under study [3] which may be attributed to the age factor of the trees. Gola produced consistently high fruit yield, followed by Seb and Umran under rainfed conditions in Kachchh area of Gujarat [7]. Sanaur cultivar is best suited cultivar for the Kandi area of Punjab [8]. This indicates that different cultivars are adapted to specific agroclimatic zones. Significant S^2d_i values of Muria Murhera and Chhuhara revealed their performance to be unpredictable over years. In Umran different traits had $b_i < 1$ indicating that these are least affected in unfavourable conditions. These results are in agreement with the findings of Tomar and Singh [3] and Purbey and Vyas [7]. On the other hand in Chhuhara, pulp (%), pulp:stone ratio, total soluble salts and fruit weight had $b_i > 1$ indicating these traits to be highly sensitive to environmental fluctuations.

Seb, Najuk, Gola and Sandhura Narnaul cultivars were medium yielder. However, Najuk and Sandhura Narnaul were stable cultivars owing to their unity b_i and lowest S^2d_i values. Though Seb had also unity b_i but its significant S^2d_i value for fruit yield revealed its unpredicted performance over years, which might be due to its alternative bearing behavior. Gola cultivar with $b_i > 1$ indicated that this cultivar is highly sensitive to environmental conditions and suggested its recommendation for cultivation to most favorable environments. Katha Phal and Walaiti were poor yielder. The Katha Phal was highly sensitive to environmental fluctuations while Walaiti least affected with respect to fruit yield. Total soluble salts and acidity were unpredictable in most of the cultivars as their S^2d_i values were significant, while the reaction of other traits varied from cultivar to cultivar.

In the present investigation the magnitude of regression coefficient and deviation from regression varied from cultivar to cultivar. Umran was most stable cultivar for fruit yield and most of the other traits. Gola and Katha Phal showed higher regression coefficient

values with non-significant deviations indicating that these cultivars are good yielder in better environments. Walaiti though low yielder, showed least influence of environment fluctuations. It can be concluded that Umran having high fruit yield coupled with unity regression coefficient and lowest deviation from regression coefficient, having more pulp:stone ratio, bold fruits is very stable cultivar in this region and can greatly benefit the ber growers.

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