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Short Research Article

Growth Variability and Correlation Studies in *Dolichos biflorus* L. at Two Locations

Nivedita Nandi and Jagatpati Tah

Cytogenetics and Molecular Biology Laboratory, Department of Botany (UGC CAS), The University of Burdwan, Golapbag Campus, Burdwan, West Bengal (713 104), India

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Correspondence to

E-mail: jt_botbu2012@yahoo.in

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Abstract

Thirty accessions of *Dolichos biflorus* L. were sown in two different locations *viz.,* Crop Research Farm (CRF), under the Department of Botany of the University of Burdwan and Gagnabad, Adra, Purulia following a Randomized Block Design (RBD) layout having four replications. These accessions were collected from National Bureau of Plant Genetic Resource (NBPGR), New-Delhi, during September, 2010. Seeds were sown in the field in the month of November 2010. Uniform agronomic measures were provided in both the locations for the proper growth and development of the crop. Various metrical characters were observed and all the data were recorded properly for further computations. Correlation analysis was performed among measured characters. Out of thirty accessions, seven genotypes proved themselves to be the most adaptive in both the locations of different agro-climatic conditions. Correlation values between plant height vs. pods plant^{-1}, plant height vs. leaf area, plant height vs. days to flowering, plant height vs. pod length, plant height vs. grains pod^{-1} and plant height vs. yield plant^{-1} were determined and exhibited in this context. The aims of this experiment were to explore the suitable area and congenial environment for better crop productivity amongst those two locations.

1. Introduction

Dolichos biflorus L. (Syn. *Macrotyloma uniflorum* Lam. Verdc) is an under-exploited crop commonly known as "kulti" belongs to the family Fabaceae. This traditional drought tolerant legume is known to all for its hardiness, adaptability to poor soil and adverse climatic condition. The region of maximum genetic diversity is considered to be in the Old World Tropics, especially in India and Himalayas (Zeven and de Wet, 1982). Formerly, the plant was included in the genus *Dolichos,* thereafter Verdcourt assigned it to the genus *Macrotyloma* which comprises 25 species (Verdcourt, 1980). Leaves are trifoliate, stem is slender and branching, sub-erect, annual herbs and the flower is pale yellow. Pod is linear and flattened and contains 5-7 seeds. Seeds are small, 3-6 mm in diameter and flattened with shining surface. Seed color ranges from light red, brown, black or mottled (Purseglove, 1974). The alkaloid *Dolichin* A and B, pyroglutaminyl glutamine along with some flavonoids were isolated from this crop (Incham et al., 1981; Handa et al., 1990). The presence of anti-nutritional factors is a matter of concern whose significant portion were removed by de-hulling (Sudha et al., 1995). The fodder being rich in protein, it is widely used as a feed to animals like horses (Prakash et al., 2008). Isolation of Kaempferol-3-O-β-D-glucoside, β-sitosterol and stigmasterol (Kawsar et al*.,* 2003) and phenolic compounds (Kawsar et al., 2008a) were carried out from this crop plant. Significant haemolytic activity was exhibited by the fractionated crude extract of 1-butanol (Kawsar et al., 2009). Water stress decreased N concentration in leaves and roots but increased stem N concentration. Nitrate concentration and nitrate reductase activity in leaves were decreased by stress. Proline accumulation due to water stress was greater in stems and roots than in leaves. With the exception of glutamic acid leaf concentrations of various amino acids increased in stressed plants (Nigwekar and Chavan, 1990).

Drought is one of the major abiotic stresses affecting the agricultural production worldwide. A generally drought tolerant legume, horsegram was chosen to compare and decipher the biochemical mechanisms of drought stress tolerance (Bharadwaj and Yadav, 2012). High temperature and salinity are the major ecological factors challenging crop productivity in the arid and semiarid regions of the world. Effects of high temperature (43-45°C) and salt stress (0.6 M) on *Macrotyloma uniflorum* (Lam.) Verdc. (Horse gram), were evaluated in terms of antioxidants and antioxidant enzymes. Both treatments

caused typical stress responses in this tropical Leguminosae (Naji and Devaraj, 2011). Environmental stress, particularly heat shock, has been shown to alter gene expression in a variety of plants (Sachs and HO, 1986).

2. Materials and Methods

In this study thirty accessions of *Macrotyloma uniflorum* were considered. The seeds were obtained from the National Bureau of Plant Genetic Resources (NBPGR), New Delhi. These were sown in two different locations viz., Crop Research Farm (CRF), under the Department of Botany of The University of Burdwan (Location-2) and Gagnabad, Adra, District: Purulia (Location-1) following a Randomized Block Design (RBD) layout with four replications of each accession. Traditional organic compost and vermicompost in equal ratio (1:1) at the rate of 400 kg ha^{-1} was applied directly in the field before seed sowing. In addition to that 30 kg potash and 30 kg phosphate $hectare^{-1}$ were applied along with the organic manure but no chemical nitrogen fertilizer was applied. The agronomic practices and the control of pests and diseases were given due attention for raising healthy crop. Plant height was measured once only which was used in all case for calculation of other correlation values. Other metrical characters viz. pods $plant^{-1}$, laef area (cm), days to flowering, pod length (cm), grains pod^{-1} , yield $plant^{-1}$ were observed and all possible data were recorded properly for further calculations. All these data were tabulated for calculating correlation following Singh and Chaudhary, 1985. The correlation tables with bi-variate data have been cited in the results (Table 1 to 6). Indeed, the soil environment of Purulia district is no doubt draught prone condition and soil is rich of rock phosphate. Plant growth is basically more or less shunted than the plant grown in the field of CRF, Burdwan University. Those above metrical characters were exhibited for drawing a comparision of those two locations which are as follows in the next chapter.

3. Results and Discussion

The crop grown in Purulia prevailing water stress environment and the selected correlation values between plant height vs. leaf area and plant height vs. pod length were found to be positively correlated. In case of the crop grown in Burdwan the correlation value between plant height vs. pods $plant^{-1}$, plant height vs. pod length, plant height vs. grains pod^{-1} and plant height vs. yield $plant^{-1}$ were found to be positively correlated. The crop grown in Burdwan exhibited good crop health and greater positive correlation values than that of the crop grown in Purulia. It is clearly evident that the maximum positive correlation value indicates the genotypic efficiency and potentiality over the locations.

Each and every metrical character in both the locations exhibited bi-variate data Table (Table 1 to 12) and the r value in each character of individual location was highlighted under each Table. A combined Table for all r-values has been cited (Table 13) for accumulating all the r values in a single Table to look into these at a glance.

It is most interesting that no pathogenic and insect attack were noticed during the growth phase of the crop in the field. This might be due to the effect of organic farming applied to the crop.

This finding suggest that the possibility of the synthesis of chemical components like phosphorus and potassium are influenced. Though, no experiment was conducted for analyzing the quantity of phosphorus and potassium, but it is known to all that there are abundance of phosphate in the small hills in the district of Purulia. But, in the district of Burdwan, the experiment was conducted in the research field of the Crop Research Farm under the department of Botany which is no doubt a controlled farm condition. There is no question of any water stress factor whereas, in the district of Purulia is very much known for suffering from water stress i.e. darought

Table 1: Comparison between plant height (cm) and pods $plant^{-1}$ (no.) at Location-I

Accession no.	Plant height (x)	Pods $plant^{-1}$ (y)	x^2	y^2	xy
IC 24842	13.30	87.38	176.89	7635.26	1162.15
IC 277677	42.93	78.80	1842.98	6209.44	3382.88
IC 267941	35.77	71.30	1279.49	5083.69	2550.40
IC 89032	38.13	102.93	1453.90	10594.58	3924.72
IC 320970	37.70	95.03	1421.29	9030.70	3582.63
IC 49552	40.13	88.08	1610.42	7758.09	3534.65
IC 9623	41.33	64.40	1708.17	4147.36	2661.65
∑	249.29	587.92	9493.14	50459.12	20799.08

r value =-0.17

Table 2: Comparison between plant height (cm) and Leaf area (cm^2) at Location-I

Accession no.	Plant height (x)	Leaf area (y)	x^2	Y^2	xy
IC 24842	13.30	3.77	176.89	14.21	50.14
IC 277677	42.93	5.29	1842.98	27.98	227.10
IC 267941	35.77	4.91	1279.49	24.11	175.63
IC 89032	38.13	4.46	1453.90	19.89	170.06
IC 320970	37.70	4.56	1421.29	20.79	171.91
IC 49552	40.13	4.08	1610.42	16.65	163.73
IC 9623	41.33	4.38	1708.17	19.18	181.03
∑	249.29	31.45	9493.14	142.81	1139.60

r value=0.64

Table 3: Comparison between plant height (cm) and days to flowering

Accession no.	Plant height (x)	Days to flower-ing (y)	x^2	y^2	xy
IC 24842	13.30	87.13	176.89	7591.64	1158.83
IC 277677	42.93	80.65	1842.98	6504.42	3462.30
IC 267941	35.77	87.48	1279.49	7652.75	3129.16
IC 89032	38.13	78.00	1453.90	6084.00	2974.14
IC 320970	37.70	87.03	1421.29	7574.22	3281.03
IC 49552	40.13	85.48	1610.42	7306.83	3430.31
IC 9623	41.33	86.20	1708.17	7430.44	3562.65
∑	249.29	591.97	9493.14	50144.30	20998.42

r value=0.37

Table 4: Comparison between plant height (cm) and pod length (mm) at Location-I

Accession no.	Plant height (x)	Pod length (y)	x^2	y^2	xy
IC 24842	13.30	37.95	176.89	1440.20	504.74
IC 277677	42.93	40.25	1842.98	1620.06	1727.93
IC 267941	35.77	40.50	1279.49	1640.25	1448.69
IC 89032	38.13	43.50	1453.90	1892.25	1658.66
IC 320970	37.70	39.63	1421.29	1570.54	1494.05
IC 49552	40.13	35.88	1610.42	1287.37	1439.86
IC 9623	41.33	39.63	1708.17	1570.54	1637.91
∑	249.29	277.34	9493.14	11021.21	9911.84

r value=0.25

Table 5: Comparison between plant height (cm) and Grains pod^{-1} (no.) at Location-I

Accession no.	Plant height (x)	Grains pod^{-1} (y)	x^2	y^2	xy
IC 24842	13.30	5.25	176.89	27.56	69.83
IC 277677	42.93	3.63	1842.98	13.18	155.84
IC 267941	35.77	4.00	1279.49	16.00	143.08
IC 89032	38.13	4.63	1453.90	21.44	176.54
IC 320970	37.70	3.88	1421.29	15.05	146.28
IC 49552	40.13	3.63	1610.42	13.18	145.67
IC 9623	41.33	4.13	1708.17	17.06	170.69
∑	249.29	29.15	9493.14	123.47	1007.93

r value=0.84

Table 6: Comparison between plant height (cm) and Yield plant^{-1} (no.) at Location-I

Accession no.	Plant height (x)	Yield plant^{-1}- (y)	x^2	y^2	xy
IC 24842	13.30	419.48	176.89	175963.47	5579.08
IC 277677	42.93	387.15	1842.98	149885.12	16620.35
IC 267941	35.77	338.98	1279.49	114907.44	12125.31
IC 89032	38.13	517.08	1453.90	267371.73	19716.26
IC 320970	37.70	483.43	1421.29	233704.57	18225.31
IC 49552	40.13	429.05	1610.42	184083.90	17217.78
IC 9623	41.33	317.68	1708.17	100920.58	13129.71
∑	249.29	2892.85	9493.14	1226836.81	102613.80

r value=0.78

Table 7: Comparison between plant height (cm) and pods plant^{-1} (no.) at Location-II

Accession no.	Plant height (x)	Pods plant^{-1} (y)	x^2	y^2	xy
IC 24842	30.21	92.13	912.64	8487.94	2783.25
IC 277677	46.96	81.20	2205.24	6593.44	3813.15
IC 267941	44.27	73.03	1959.83	5333.38	3233.04
IC 89032	84.33	104.25	7111.55	10868.06	8791.40
IC 320970	43.17	98.70	1863.65	9741.69	4260.88
IC 49552	46.17	92.65	2131.67	8584.02	4277.65
IC 9623	21.42	69.83	458.82	4876.23	1495.76
∑	316.53	611.79	16643.40	54484.76	28655.13

r value=0.64

Table 8: Comparison between plant height (cm) and Leaf area (cm^2) at Location-II

Accession no.	Plant height (x)	Leaf area (y)	x^2	y^2
IC 24842	30.21	6.63	912.64	43.96
IC 277677	46.96	4.92	2205.24	24.21
IC 267941	44.27	4.78	1959.83	22.85
IC 89032	84.33	4.62	7111.55	21.34
IC 320970	43.17	4.99	1863.65	24.90
IC 49552	46.17	3.13	2131.67	9.80
IC 9623	21.42	4.55	458.82	20.70
∑	316.53	33.62	16643.40	167.76

r value=-0.25

-prone areas. These observations were in accordance with the findings of Tank and Etzler (1988) and Halemani et al. (1989). Water stress was found to be most effective in relation to the stomatal behaviour (Nigwekar, 2010).

The plant vs. leaf area and days to flowering were shown negative values in case of location-II (r-values are -0.025 and -0.072 respectively). similarly, in location I, the r-value of plant height vs days to flowering was -0.037 and the r-values of plant height vs. grain pod^{-1} and yield plant^{-1} were -0.84 and -0.09 respectively (in Table 13) which indicated no-healthy plant

Table 9: Comparison between plant height (cm) and days to flowering at Location: II

Accession no.	Plant height (x)	Days to flower-ing (y)	x^2	y^2	xy
IC 24842	30.21	80.70	912.64	6512.49	2437.95
IC 277677	46.96	79.00	2205.24	6241.00	3709.84
IC 267941	44.27	82.38	1959.83	6786.46	3646.96
IC 89032	84.33	69.35	7111.55	4809.42	5848.29
IC 320970	43.17	74.55	1863.65	5557.70	3218.32
IC 49552	46.17	72.18	2131.67	5209.95	3332.55
IC 9623	21.42	79.35	458.82	6296.42	1699.68
∑	316.53	537.51	16643.4	41413.44	23893.59

r value=0.72

Table 10: Comparison between plant height (cm) and pod length (mm) at Location-II

Accession no.	Plant height (x)	Pod length (y)	x^2	y^2	xy
IC 24842	30.21	40.40	912.64	1632.16	1220.48
IC 277677	46.96	43.28	2205.24	1873.16	2032.43
IC 267941	44.27	39.73	1959.83	1578.47	1758.85
IC 89032	84.33	42.80	7111.55	1831.84	3609.32
IC 320970	43.17	42.48	1863.65	1804.55	1833.86
IC 49552	46.17	42.30	2131.67	1789.29	1952.99
IC 9623	21.42	44.20	458.82	1953.64	946.76
∑	316.53	295.19	16643.40	12463.11	13354.69

r-value=0.04

Table 11: Comparison between plant height (cm) and grains pod^{-1} (no.) at Location-II

Accession no.	Plant height (x)	Grains pod^{-1} (y)	x^2	y^2	xy
IC 24842	30.21	4.25	912.64	18.06	128.39
IC 277677	46.96	3.75	2205.24	14.06	176.10
IC 267941	44.27	3.75	1959.83	14.06	166.01
IC 89032	84.33	4.88	7111.55	23.81	411.53
IC 320970	43.17	5.25	1863.65	27.56	226.64
IC 49552	46.17	5.10	2131.67	26.01	235.47
IC 9623	21.42	4.05	458.82	16.40	86.75
∑	316.53	31.03	16643.40	139.96	1430.89

r value=0.37

population and plant canopy. In case of yield plant^{-1} indicates soil factors, genotypic potentiality, agronomic measures and other environmental factors of the crop. So, it is simply evident that location-II was better than that of location-I . similar results observed by Sood et al. (1994), Roopadevi et al. (2002), Parmeet Singh et al. (2007).

Table 12: Comparison between plant height (cm) and yield plant^{-1} (no.) at Location-II

Accession no.	Plant height (x)	Yield plant^{-1} (y)	x^2	y^2	xy
IC 24842	30.21	425.55	912.64	181092.80	12855.87
IC 277677	46.96	412.93	2205.24	170511.19	19391.19
IC 267941	44.27	389.38	1959.83	151616.78	17237.85
IC 89032	84.33	541.70	7111.55	293438.89	45681.56
IC 320970	43.17	509.68	1863.65	259773.70	22002.89
IC 49552	46.17	453.10	2131.67	205299.61	20919.63
IC 9623	21.42	345.28	458.82	119218.28	7395.90
∑	316.53	3077.62	16643.40	1380951.25	145484.89

r value=0.09

Table 13: Comparison of correlation values of various plant characters in two locations

Plant character	Research location	
	Burdwan	Purulia
Plant height vs. Pods plant^{-1}	0.64	-0.17
Plant height vs. Leaf area	-0.25	0.64
Plant height vs. Days to flowering	-0.72	-0.37
Plant height vs. Pod length	0.04	0.25
Plant height vs. Grains pod^{-1}	0.37	-0.84
Plant height vs. Yield plant^{-1}	0.78	-0.09

The stomatal function directly helps to promote the photosynthetic activities of any crop. The crop yield and productivity is directly regulated by the photosynthetic activities (Varisai et al*.,* 2004 and Mohamed et al*.,* 2005).

4. Conclusion

The correlation study exhibited the genotypic efficiency and potentiality on the soil characteristics and agro climatic conditions. These genotypes will yield more in favourable soil status and environment.

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