Madras Agric. J., 100 (1-3): 57-61, March 2013
https://doi.org/10.29321/MAJ.10.001238

Seasonal Influence on Physiological Parameters and Yield of Dolichos Bean (*Dolichos lablab* (Roxb.) (L) var. *typicus*) Genotypes

R. Dhivya[1*], K. Venkatesan[1], P. Jeyakumar[2] and L. Pugalendhi[1]
[1]Department of Vegetable Crops, [2]Department of Crop Physiology
Tamil Nadu Agricultural University, Coimbatore - 641 003

The response of Dolichos bean genotypes to different seasons in relation to physiological parameters and yield was studied during 2009-2010. Leaf area, light interception, specific leaf weight, chlorophyll content, chlorophyll stability index and relative water content differed with genotypes and seasons. With respect to genotypes, Dbp-3 recorded the highest leaf area, total dry matter production, light interception, specific leaf weight, chlorophyll content, chlorophyll stability index and relative water content which in turn reflected on yield. The early sown crop i.e. crop sown at July-August season resulted in good development of physiological characters as well as yield. Among the treatment combinations, the highest value of physiological parameters and yield was recorded in Dbp-3 sown during July-August season.

Key words: Dolichos bean, season, physiological parameters, yield

Dolichos bean, an important legume vegetable crop is grown in an area of 600 ha with annual production of 9000 tonnes and average productivity of 15.0 t/ha (Sidhu, 2002). Dolichos bean is otherwise called as Indian bean or hyacinth bean, lablab bean or Egyptian bean or bonavista vine or Australian pea or Chicaros or Chink or Pharao. The flower colour, size, shape and type of pods of this crop differs from strain to strain. It is a good source of protein, minerals, vitamins (Basu *et al*. 2002) and it is antihypertensive (Bradley, 1999). It is mainly grown for the consumption as green pods or green seeds and dry seeds are used as pulse.

The physiological characters and yield potential of a crop depend on the environmental conditions prevailing during its growth. The positive effect of environmental factors on growth and yield could be harnessed if the information on optimum time of sowing is made available. With the availability of improved varieties, the crop is gaining importance in Southeastern hilly region of the country in a big way. Optimum sowing date plays a decisive role in growth and production of French bean as the crop experiences cooler phase (end of December to January) during later stage of crop growth (Singh *et al.,* 1992). However, owing to lack of information on specific agro-climatic requirements for potential yield, the realised yield is far below the potential. Different cultivars require different sowing times and if a good cultivar is sown at proper time, it may give the maximum yield. Therefore, proper time of sowing is critical to increase the productivity. An attempt was made to find out a suitable variety and optimum sowing time or season under climatic region of Coimbatore.

*Corresponding author email: sikkaldivi@gmail.com

Materials and Methods

A field experiment was conducted at Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore during 2009-2010 to study the influence of seasons on physiological parameters and yield of Dolichos bean genotypes. The experiment was laid out in a factorial randomized block design with four replications in three seasons of sowing *viz*., July-August, September-October and December-January (Factor A) with three genotypes *viz*., CO-1, Dbp-3 and Dbp-4 (Factor B). The soil of the experimental site was sandy loam. The soil was having medium available nitrogen (220.5 kg ha^{-1}), phosphorus (19.2 kg ha^{-1}) and potassium (280.6 kg ha^{-1}).

Three seeds of each Dolichos bean genotype CO-1, Dbp- 3 and Dbp- 4 were sown per pit at a spacing of 2 m × 1.5 m. Irrigation was given immediately after sowing and on 3rd day, and once in a week thereafter through drip irrigation. FYM was applied at the rate of 20 t / ha and 100 g of NPK 6:12:12 mixture as basal and 10 g of N per pit was applied on 30 days after sowing. 2kg each of *Azospirillum* and *Phosphobacteria* per ha was applied at the time of sowing. Since the plants are indeterminate, they were trailed over pandal and the side branches were removed up to the height below the pandal in all the three genotypes. Pinching was done to promote flowering.

Observations on physiological attributes like leaf area (Leaf Area Meter: Li-Cor Model 3100), total dry matter production (Turner, 1981), light interception Neliat *et al*. 1974), specific leaf weight (Pearce *et al*., 1968), chlorophyll content (Yoshida *et al*., 1971), chlorophyll stability index (Koleyoreas,1958) and relative water content (Weatherly, 1965) and green pod yield were recorded.

Results and Discussion

Leaf area

Among the genotypes, Dpb-3 and among the seasons, July-August season recorded higher leaf area (3.59 m^2 $plant^{-1}$ and 4.54 m^2 $plant^{-1}$ respectively). Regarding the treatment combination, Dpb-3 sown during July-August season recorded significantly better leaf area (Table 1.). Since the net photosynthesis is dependent on leaf area per plant, higher amounts of photosynthates might have been produced and attributed for higher green pod yield in July -August sowing. This is in accordance with earlier findings of Yusufali *et al*. (2007).

Table 1. Seasonal influence on physiological parameters of Dolichos bean genotypes

	Leaf area (m^2 $plant^{-1}$)				Light interception (%)				Specific leaf weight (mg cm^{-2})			
	G_1	G_2	G_3	Mean	G_1	G_2	G_3	Mean	G_1	G_2	G_3	Mean
S_1	3.11	5.53	4.98	4.54	80.23	91.33	87.75	86.43	7.44	8.65	8.09	8.06
S_2	0.80	2.73	2.39	1.97	78.63	88.58	82.65	83.28	5.64	7.03	6.69	6.45
S_3	0.74	2.52	1.78	1.68	71.03	83.00	80.08	78.03	5.27	6.51	6.17	5.98
Mean	1.55	3.59	3.05	2.73	76.63	87.63	83.49	82.58	6.12	7.39	6.98	6.83
	S	G	SG		S	G	SG		S	G	SG	
SEd	0.083	0.083	0.143		0.469	0.469	0.813		0.040	0.040	0.070	
CD (0.05)	0.170	0.170	0.295		0.968	0.968	1.677		0.083	0.083	0.144	

S_1 Season -1 (July-August, 2009) **G_1** CO-1
S_2 Season -2 (September-October, 2009) **G_2** Dbp-3
S_3 Season -3 (December-January, 2010) **G_3** Dbp-4

Canopy development was quicker in July-August sowing than in September-October and December-January sowings, mainly due to better utilization of solar light by the July-August sown plants. Similar results were reported in pigeon pea (Balakrishnan, 1986). Maximum leaf area was recorded in July-August season crop, which decreased continuously with later sowing. It might be due to involvement of progressively lower amount of assimilate in the production of leaf area with delayed sowing (Kausale *et al*., 2006).

Total dry matter production (TDMP)

The TDMP of a crop reflects its efficiency in utilizing the available resources. The dry matter production was significantly influenced by seasons. July- August season crop recorded the highest total dry matter production (323.8 g $plant^{-1}$) followed by September-October season (Fig 1.). It might be due to the temperature which affects the synthesis and accumulation of dry matter content. This is in corroboration with the findings of Shukla and Kohli (1992) in peas.

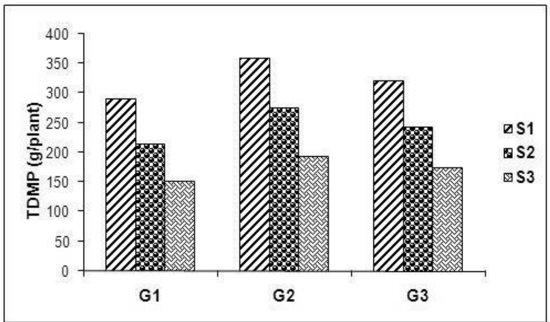

Fig 1. Seasonal influence on total dry matter production of Dolichos bean genotypes

Delay in sowing resulted in low total dry matter production and it might be due to decline in temperature prevailed during vegetative phase (0-60 DAS) and rise in temperature from 95^{th} day. Similar results were reported by Jalapathi Rao (1994) in pigeon pea. Early sowing recorded highest dry matter production and significant reduction in delayed sowing. This is in accordance with the earlier findings (Kausale *et al* ., 2006 in soybean, Abiralam *et al.,* 2008 in lablab bean).

Dbp-3 recorded the highest total dry matter production (275.8 g $plant^{-1}$). The variation in biomass production among Dolichos bean genotypes might be due to genotype phenology, environment and seasons. Similar results were also reported earlier by Ewansiha *et al*. (2007).

Light interception

The higher total dry matter production, in July-August season crop as compared to September-October and December-January season crop, was attributable to the greater amount of light interception (86.43 %). These findings were in conformity with those of Bierhuizen *et al*. (1973) and Rajendran (1991). Muhammed Azam *et al*. (2002) revealed that early sowing crop had increased radiation interception by 80 per cent over late sowing.

A close scrutiny of the data on light interception in all the three seasons especially at 90 DAS suggested that there existed marked differences between genotypes. Dbp-3 was found to have higher ground area cover as compared to other two genotypes in all the three seasons. It evidently exhibited greater light interception because of greater canopy development. Similar finding was reported by Rajendran (1991) who found the fraction of radiation intercepted by a crop depends mainly on its leaf area index. July-August sowing could generate higher leaf area development resulting in greater ground area coverage in contrast to December-January season. The trend indicated better harnessing of solar energy by the plants in July-August season and especially the genotype, Dbp-3 which was greatly benefited by having higher leaf area. Dbp-3, as a long duration genotype

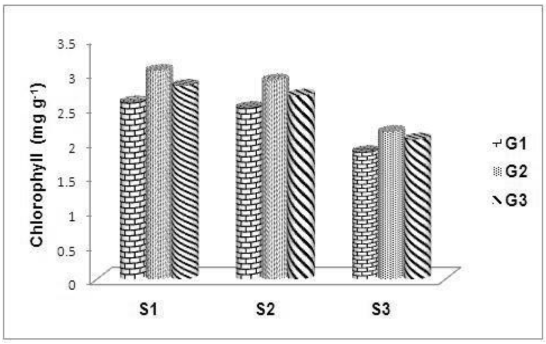

Fig 2. Seasonal influence on chlorophyll content of Dolichos bean genotypes

recorded higher ground area and intercepted more light than short duration genotype. Similar results were reported in pigeon pea (Balakrishnan, 1986).

Specific leaf weight

Among the seasons, July -August season crop recorded highest Specific leaf weight with a value of 8.06 at 120 DAS (Table 1.). This was followed by the September-October season crop with a value 6.45. Early sown (i.e) July-August season crop had maximum specific leaf weight values than the delayed sowing crop. Similar results were reported in mungbean by Gopal Singh *et al*. (1985). Among the genotypes, Dbp-3 recorded higher specific leaf weight (7.39 mg cm^{-2}) followed by Dbp-4 (6.98 mg cm^{-2}). This might be due to varietal difference among the genotypes. This is in accordance with earlier findings in mungbean (Kuo *et al*., 1980).

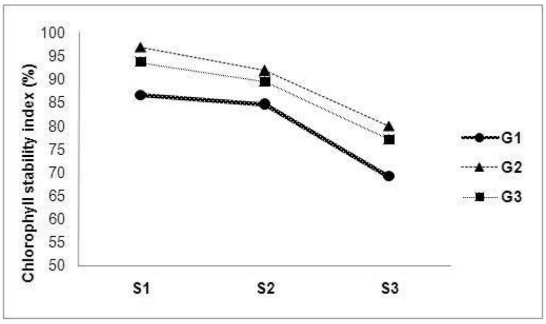

Fig 3. Seasonal influence on Chlorophyll Stability Index of Dolichos bean genotypes

Chlorophyll content

Chlorophyll, the pigment responsible for converting light energy into chemical energy, is directly associated with the photosynthetic efficiency of crop plants. The enhancement of chlorophyll content was observed with the seasons. At 120 DAS, the total chlorophyll content increased in July-August season crop (2.80 mg g^{-1}) than the September-October season crop (2.68 mg g^{-1}) (Fig 2.).

Crop sown during December-January recorded the lowest chlorophyll content due to unfavourable environment (i.e) low night temperature during 60 to 90 days. Similar results were reported by Sato and Park (1981). Early sown crop show a greater increase in the rate of photosynthesis than the late sown crop which may be due to increase in the content of total chlorophyll. Among the genotypes, Dbp-3 recorded highest chlorophyll content followed by Dbp-4. Differences in leaf chlorophyll content among cultivars in several crops (Gopal Singh *et al*., 1985 and Chandra Babu *et al*., 1988) lend support to this finding.

Chlorophyll Stability Index (CSI) and Relative water content (RWC)

Both CSI and RWC were highly influenced by seasons. July-August season crop recorded highest chlorophyll stability index (92.45 %) and relative water content (83.61%) and lowest was observed in December-January season (Fig 3 & 4). Reduction in relative water content could be attributed to the

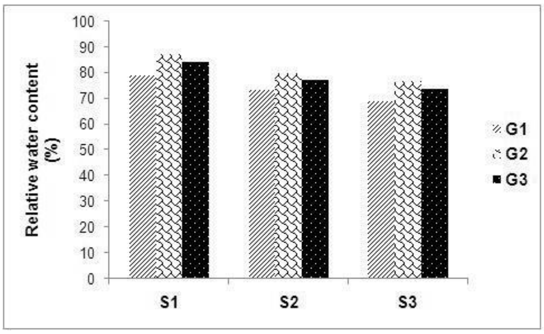

Fig 4. Seasonal influence on Relative Water Content of Dolichos bean genotypes

variations in maintaining the internal water balance on account of continuous evaporation loss during crop growth. Higher relative water content is well correlated with biomass production and grain yield under water stress conditions (Teerlat *et al.,* 1997). The chlorophyll stability index and relative water content were found the highest in Dbp-3 (86.78 and 61.38 % respectively) followed by Dbp-4.

Green pod yield

The green pod yields of Dolichos bean were significantly different among the seasons. The highest green pod yield of 18.89 t ha^{-1} was recorded with July-August season crop followed by

September-October season crop (Table 2). In July-August season sowing, the accumulated heat units were higher and the energy was utilized for production of excessive vegetative growth attributes (plant height and total number of branches per plant) which resulted in higher absorption of PAR, lower temperature and highest relative humidity due to transpirational cooling as compared to later sowing. Most of the pole types of Dolichos bean, being photosensitive and short day type, they have not performed well under late sown conditions i.e. September-October season. Therefore, there was a drastic reduction in green pod yield than the July-August season crop due to reduced period and less availability of accumulated heat units for different phenophases. This resulted in stunted plants with lower values of growth and yield attributes in September-October than July-August season crop. This is in accordance with the earlier findings of Taneja *et al*. (1995) in cluster bean.

Table 2. Seasonal influence on yield in Dolichos bean genotypes

	Green pod yield per plant (kg)				Green pod yield (t/ha)			
	G_1	G_2	G_3	Mean	G_1	G_2	G_3	Mean
S_1	3.95	7.85	5.99	5.93	12.69	23.43	20.55	18.89
S_2	1.44	3.87	2.74	2.68	4.75	12.13	8.39	8.42
S_3 *	-	-	-	-	-	-	-	-
Mean	2.69	5.86	4.37	4.31	8.72	17.78	14.47	13.65
	S	G	SG		S	G	SG	
SEd	0.065	0.079	0.112		0.169	0.207	0.293	
CD (0.05)	0.138	0.169	0.239		0.361	0.442	0.624	

*Observations were not taken in S_3 as the crop remained vegetative as on June, 2010.

Dbp-3 recorded highest green pod yield (17.78 t/ha) followed by Dbp-4 (14.47 t/ha) and it might be due to increased number of pickings owing to prolonged crop duration compared to CO-1. Similar results were reported by Shukla and Kohli (1992) in peas. Green pod yield is a cumulative performance of pod numbers, pod length, pod width and pod weight. Enhancement in yield attributes would ultimately culminate into pod yield of each genotype. Similar studies regarding genotype variation for different attributes in other plants were reported by Idrees *et al.* (2007), Morris (2008) and Naeem *et al*. (2009). Significantly higher leaf area per plant and leaf area index in Dbp-3, and the possibly higher net photosynthates might have attributed for higher green pod yield reported by as. Yusufali *et al*. (2007) in field bean.

Conclusion

From this study, it can be concluded that Dbp-3 genotype sown during July-August had better growth in term of more leaf area, TDMP, light interception, specific leaf weight, chlorophyll content, CSI and RWC and finally resulted in higher pod yield than Dbp-4 and CO-1.

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Received: September 4, 2012; Accepted: November 11, 2012