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Studies on Seasonal Influence on Yield and Quality of Dolichos Bean Genotypes

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ABSTRACT

Background: Dolichos bean [*Dolichos lablab* (Roxb.) (L) Var. *typicus*] is one of the most important leguminous vegetable crops cultivated in tropical plains of India. The mature and immature pods are rich in protein, minerals and vitamins. Most of the pole types of dolichos beans are photosensitive in nature, suited for growing in specific season like *kharif* and not productive when grown in summer season. Different cultivars of Dolichos bean require different seasons for getting maximum yield. With this background, studies on seasonal influence on growth and yield of dolichos bean genotypes were carried out.

Methods: An experiment was conducted to assess the effect of season and genotypes in Dolichos bean. The experiment was laid out in factorial randomized block design with nine treatment combinations and four replications. In this study, three genotypes of dolichos bean *viz*., CO 1, Dbp-3 and Dbp-4 were sown during *kharif*, *rabi* and winter seasons.

Result: The main and interaction effects on genotypes and season of sowing had a significant influence on green pod yield, crude fibre, crude protein and total dry matter production. The genotype Dbp-3 sown during *kharif* season recorded the highest values for green pod yield (23.43 $t.ha^{-1}$), crude protein (5.99%), dry matter production at various stages of growth (65.9, 254.3, 305.8, 359.2, 389.8 and 418.0 $g.plant^{-1}$ at 30, 60,90,120,150,180 days after sowing respectively) and it was significantly different from all other treatments. The same treatment *i.e*., genotype Dbp-3 sown during *kharif* season was recorded the lowest amount of crude fibre content (1.53%).

Key words: Dolichos bean, Dry matter, Fibre, Genotype, Growth, Protein, Season, Yield.

INTRODUCTION

Dolichos bean [*Dolichos lablab* (Roxb.) (L.) Var. *typicus*] is one of the important leguminous vegetable crops of India. Dolichos bean is otherwise called as Indian bean or hyacinth bean or sem or lablab bean or Egyptian bean or bonavista vine or Australian pea or Chicaros or Chink or Pharao or Avarai in Tamil. Apart from India, it is also common in Africa, extending from Cameroon to Swaziland and Zimbabwe, through Sudan, Ethiopia, Uganda, Kenya and Tanzania (Maruthi *et al*., 2006). In India, it is grown extensively in Madhya Pradesh, Maharashtra, Andhra Pradesh, Uttar Pradesh, Kerala and Tamil Nadu (Rai and Yadav, 2005). It is mainly grown for the consumption of green pods, green seeds and dry seeds are used as pulse. Immature pods are cooked and consumed as vegetables; mature seeds are cooked and consumed as a pulse. Seeds are alexeritic, antispasmodic, aphrodisiac, febrifugal, stomachic and antihypertensive (Bradley, 1999). Leaves are also used for the treatment of colic, gonorrhoea and leukorrhoea. It is a good source of protein, minerals, vitamins (Basu *et al*., 2002). The nutritional composition as reported by Duke (1981) is that dried seeds contain 21.5% protein, 98 mg calcium, 345 mg phosphorus and 3.9 mg iron per 100 gram while green pods contain 3.1% protein, 95 mg of calcium, 50 mg of phosphorus and 1.2 mg of iron per 100 gram. Seed contain trypsin and chymotrypsin inhibitors and is said to be rich source of catechol oxidase.

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The crop requires a warm tropical climate. In Dolichos bean, there are two distinct groups based on growth habit. One is pole type which requires pole or arbour as a support for the growing vine and the other is bush type and has bushy growth habit and hence does not require any support. Most of the pole types are photosensitive, suited for growing in specific season like *kharif* and will not produce flowers

when grown in summer season. Dolichos bean can be grown in tropical and subtropical regions.

The growth 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. 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. With this background, the present study was undertaken to study the effect of season on growth, yield and quality of Dolichos bean genotypes and to identify the best Dolichos bean genotype for commercial cultivation.

MATERIALS AND METHODS

The experiment was conducted at the College Orchard of Tamil Nadu Agricultural University, Coimbatore. The field experiment was laid out in factorial randomized block design (FRBD) with nine treatments and four replications as detailed below:

Factor I - Season of sowing

S_1- *Kharif* (July- August)
S_2- *Rabi* (September- October)
S_3- Winter (December- January)

Factor II - Genotype

G_1- CO1
G_2- Dbp-3
G_3- Dbp-4

Five randomly selected plants were used to record various observations. The observations *viz*., green pod yield (kg) per plant, green pod yield (kg) per plot (10 m^2), yield (t) per hectare, crude protein content (%), crude fibre content (%) and total dry matter production (g) per plant were recorded.

The total dry matter production was recorded at six stages of crop growth *viz*., 30 days after sowing (vegetative stage), 60 days after sowing (flowering stage), 90, 120, 150 and 180 days after sowing (harvest stages). The immature fruit samples were taken at optimum harvest stage and the fresh weight was recorded. The fruits were cut into pieces and placed in oven and dried at 60°C for 72 hours until the weight got stabilized and the dry weight of the samples was recorded. From the recorded values, the per cent of dry matter was calculated (Ahmed *et al*., 1999).

The crude protein content in the pods at optimum harvest stage was estimated as per the method described by Lowry *et al*. (1951). The sample was taken from the immature pods at optimum harvest stage. Fruit sample of 500 mg was ground well with pestle and mortar in 5 to10 ml of the phosphate buffer solution and centrifuged for 10 minutes at 15,000 rpm. The protein stock solution was prepared by dissolving 50 mg of Bovine Serum Albumin (BSA) in 50 ml distilled water, which served as stock standard. Ten ml of the stock solution was diluted to 50 ml with distilled water, which served as working standard. Series of 0.2, 0.4, 0.6, 0.8 and 1 ml of the working standard were pipetted out into test tubes. Sample extracts of 0.1 ml and 0.2 ml were pipetted out into two other test tubes. The volume was made up to 1 ml in all the test tubes with distilled water. A test tube with 1 ml of distilled water served as blank. Five ml of alkaline copper solution (prepared by mixing 2 per cent sodium carbonate in 0.1N sodium hydroxide with 0.5 per cent copper sulphate in 1 per cent potassium sodium tartrate in 50:1 ratio) was taken and added to each test tube including blank, mixed well and allowed to stand for 10 minutes. Folin - ciocalteau reagent 0.5 ml (prepared by adding 100 g of sodium tungstate, 25 g of sodium molybdate, 700 ml of water, 50 ml of 85 per cent phosphoric acid, 100 ml of concentrated HCl and 150 g of lithium sulphate in 50 ml of water and a few drops of bromine water. The mixture was boiled for 15 minutes, cooled and diluted to 1 litre and filtered) was added to each test tube, mixed well and the test tubes were incubated at room temperature in the dark for 30 minutes. Samples on development of blue colour in the solution, measured at 660 nm. The standard graph was drawn and the amount of protein in each sample was calculated and expressed in per cent.

The crude fibre content of pods at optimum harvest stage was estimated by the method of Chopra and Kanwar (1976).

The data were subjected to statistical scrutiny by Panse and Sukhatme (1985). The ANOVA and critical difference at five per cent level of significance were calculated.

RESULTS AND DISCUSSION

Green pod yield

The highest green pod yield of 18.89 t ha^{-1} was recorded with *kharif* (July-August) season crop followed by *rabi* (September-October) season crop (8.42 t ha^{-1}). The highest green pod yield was recorded with early sowing and there was significant reduction in yield in successive seasons of sowing. The findings from the present work are also in line with the findings of Venkateswarlu and Rajan (1991), Sheoran *et al*. (2007) and Yusufali *et al*. (2007). Higher amounts of photosynthates might have been produced and attributed for higher green pod yield in *kharif* season sowing. This might be due to optimum temperature and more sunshine hours prevailed during the vegetative phase of growth being Dolichos bean as photosensitive. Sharma *et al*. (2008) reported that superior performance was observed in different growth stages in early sowing was

mainly due to longer growth period. But the seeds sown in December failed to flower, due to unfavourable environmental conditions as reported previously in French bean (Begum *et al*., 2003).

Dbp-3 recorded highest green pod yield (17.78 t ha^{-1}) followed by Dbp-4 (14.47 t ha^{-1}) and it might be due to increased number of pickings owing to prolonged crop duration compared to CO-1 and genotype variation (Table 1). Similar results were reported by Shukla and Kohli (1992) in peas. Similar studies regarding genotype variation for yield attributes in other plants were reported by Idrees *et al*. (2007), Morris (2008) and Naeem *et al*. (2009).

Dbp-3 recorded more leaf area than the other two genotypes, it might be due to differences in their genetic makeup and the environmental conditions.

Quality parameters

The present investigation revealed that both season and genotype had significant on protein content of pods. *Kharif* (July-August) season crop recorded higher pod protein content (5.56%) than *rabi* (September-October) season crop (4.87%). Sharma *et al*. (1984) revealed that the cluster bean sown on 5 July recorded significantly higher protein percentage than the crop sown on 20 June, 20 July and 5 August. Sharma *et al*. (1989) also reported that the highest protein content was recorded with early date of sowing (13 July) and there was significant reduction in protein content in successive dates. The protein content was maximum in the crop sown on 10 June at Kalpa and 25 August at Solan in pea (Shukla and Kohli, 1992). Among the genotypes, Dbp-3 recorded higher protein content (5.56%) than the other two genotypes (Table 2).

Considering the season, *kharif* (July-August) sown crop recorded lower crude fibre content (1.68 %) than the *rabi* (September-October) sown crop. Dbp-3 recorded lower crude fibre content (1.74%) followed by Dbp-4 (1.94%) and CO-1(2.10%). This might be due to variation in genetic makeup and environment. Srinivasan (2003) revealed that the lowest crude fibre content was recorded in CM 2 and CM 24 genotypes in pumpkin lend support to the present findings.

Dry matter production

The dry matter production was significantly influenced by seasons. *Kharif* (July-August) season crop recorded the highest total dry matter production at all the stages followed by *Rabi* (September-October) season (Table 3). It might be due to 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. Dbp-3 recorded the highest total dry matter production at all the phenological stages. Variation in biomass production among Dolichos bean genotypes, it might be due to genotype

Table 1: Effect of genotypes and seasons on green pod yield of Dolichos bean.

	Yield per plant (kg)				Yield per plot (kg)				Green pod yield (t/ha)			
	G_1	G_2	G_3	Mean	G_1	G_2	G_3	Mean	G_1	G_2	G_3	Mean
S_1	3.95	7.85	5.99	5.93	12.70	23.40	20.60	18.90	12.69	23.43	20.55	18.89
S_2	1.44	3.87	2.74	2.68	4.70	12.10	8.40	0.84	4.75	12.13	8.39	8.42
S_3	-	-	-	-	-	-	-	-	-	-	-	-
Mean	2.69	5.86	4.37	4.31	8.70	17.80	14.50	1.37	8.72	17.78	14.47	13.65
	S	**G**	**SG**		**S**	**G**	**SG**		**S**	**G**	**SG**	
SEd	0.065	0.079	0.112		0. 17	0.20	0.29		0.169	0.207	0.293	
CD (P:0.05)	0.138	0.169	0.239		0.35	0.43	0.61		0.361	0.442	0.624	

*Observations were not taken in S_3 as the crop remained vegetative.

S_1: *Kharif* (July-August); S_2: *Rabi* (September-October); S_3: Winter (December-January); G_1: CO-1; G_2: Dbp-3; G_3: Dbp-4.

Table 2: Effect of genotypes and seasons on crude protein and fibre of Dolichos bean.

	Crude protein content (%)				Crude fibre content (%)			
	G_1	G_2	G_3	Mean	G_1	G_2	G_3	Mean
S_1	5.17	5.99	5.52	5.56	1.82	1.53	1.69	1.68
S_2	4.58	5.14	4.90	4.87	2.39	1.95	2.20	2.18
S_3^*	-	-	-	-	-	-	-	-
Mean	4.87	5.56	5.21	5.21	2.10	1.74	1.94	1.93
	S	**G**	**SG**		**S**	**G**	**SG**	
SEd	0.043	0.052	0.074		0.013	0.016	0.023	
CD (P: 0.05)	0.091	0.111	0.157		0.028	0.034	0.049	

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

S_1: *Kharif* (July-August); S_2: *Rabi* (September-October); S_3: Winter (December-January); G_1: CO-1; G_2: Dbp-3; G_3: Dbp-4.

Table 3: Effect of genotypes and seasons on total dry matter production (g plant^{-1}) in Dolichos bean.

	30 DAS				60 DAS				90 DAS			
	G_1	G_2	G_3	Mean	G_1	G_2	G_3	Mean	G_1	G_2	G_3	Mean
S_1	56.6	65.9	62.1	61.5	204.5	254.3	228.8	229.2	250.3	305.8	279.5	278.5
S_2	51.0	57.0	55.1	54.4	101.5	174.0	148.5	141.3	148.5	225.0	194.3	189.3
S_3	47.0	54.7	50.9	50.9	64.5	132.8	116.5	104.6	93.5	167.8	154.5	138.6
Mean	51.5	59.2	56.0	55.6	123.5	187.0	164.6	158.4	164.1	232.8	209.4	202.1
	S	**G**	**SG**		**S**	**G**	**SG**		**S**	**G**	**SG**	
SEd	0.268	0.268	0.465		1.444	1.444	2.501		1.786	1.786	3.094	
CD (0.05)	0.554	0.554	0.959		2.979	2.979	5.160		3.685	3.685	6.383	
	120 DAS				150 DAS				180 DAS			
	G_1	G_2	G_3	Mean	G_1	G_2	G_3	Mean	G_1	G_2	G_3	Mean
S_1	291.0	359.2	321.3	323.8	314.8	389.8	359.8	354.8	327.3	418.0	380.0	375.1
S_2	214.0	275.3	243.8	244.3	228.5	315.8	280.5	274.9	261.8	354.5	316.3	310.8
S_3	152.0	193.0	174.8	173.3	178.0	229.8	214.5	207.4	193.5	238.8	224.3	218.8
Mean	219.0	275.8	246.6	247.1	240.4	311.8	284.9	279.0	260.8	337.1	306.8	301.6
	S	**G**	**SG**		**S**	**G**	**SG**		**S**	**G**	**SG**	
SEd	1.789	1.789	3.098		1.702	1.702	2.948		1.869	1.869	3.236	
CD (0.05)	3.690	3.690	6.392		3.511	3.511	6.081		3.855	3.855	6.677	

DAS- Days after sowing.

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

phenology, environment and seasons. Similar results were also reported earlier by Ewansiha *et al*. (2007).

The dry matter production was significantly influenced by seasons. The highest total dry matter production was recorded in *kharif* (July-August) season crop as compared to *rabi* (September-October) and winter (December-January) season crop. This is due to greater amount of light interception during *kharif* season. It might be due to 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. Dbp-3 recorded the highest total dry matter production at all the phenological stages. Variation in biomass production among Dolichos bean genotypes, it might be due to genotype phenology, environment and seasons. Similar results were also reported earlier by Ewansiha *et al*. (2007).

CONCLUSION

Among the seasons, there was significant difference in green pod yield. The *kharif* (July-August) season favourably increased the yield and quality attributes resulting in highest green pod yield. Interaction effect of seasons and genotypes showed that significant influence on yield and quality attributes. Higher values of yield attributes and quality were obtained in *kharif* (July-August) season crop in Dbp-3 genotype. With the background of the above results, it can be concluded that Dbp-3 in *kharif* (July-August) sowing was better to improve the growth and yield attributing parameters which will ultimately result in increasing the productivity of the crop followed by Dbp-4 and CO-1.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could have continued or potential conflict of interest.

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