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Estimation of Genetic Variability, Heritability and Genetic Advance for Yield and Yield Attributing Traits in Dolichos Bean (*Lablab Purpureus* L.)

Shailja Chauhan[1,*], Sritama Kundu[2]

[1]Ph.D Scholar, Department of Genetics and Plant Breeding, University of Agricultural Sciences, GKVK, Bengaluru, India
[2]Junior Research fellow, Department of Genetics and Plant Breeding, University of Agricultural Sciences, GKVK, Bengaluru, India
*Corresponding author

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Abstract**—** *The present experiment was conducted to determine the genetic variability, heritability, genetic advance for yield and yield-related traits in dolichos bean at UAS, Bengaluru, during rabi 2020. The experimental material comprises six bush-type dolichos bean genotypes with two local checks were evaluated for 12 morpho-metric characters in randomized block design with three replications. The mean performance of all the characters analyzed was found significant. The genotype DOLBVAR-4 (52.80cm) recorded the maximum plant height and the minimum recorded for DOLBVAR-6 (49.30cm). The genotype DOLBVAR-2 (60.80g) recorded the highest pods plant^{-1}, followed by HA 5 (60.60g) and DOLBVAR-4 (49.26g). The green pod yield hectare^{-1}was maximum for genotype DOLBVAR-2 (3.90 t/ha) followed by HA 5 (3.60 t/ha) and DOLBVAR-3 (2.74 t/ha). In contrast, DOLBVAR-5 (2.00 t/ha) yielded the lowest among all the genotypes. High PCV and GCV were observed for the number of pods plant^{-1}, pod length (cm), and pod width (cm), indicating the higher magnitude of variability for these traits and consequently more scope for their improvement through selection. High heritability coupled with high genetic advance as percent of mean was recorded for all the characters except for days to 50% flowering, primary branches plant^{-1} and plant height (cm). These results indicate these characters are under the influence of additive gene action; hence simple selection based on the phenotypic performance of these traits would be more effective.*

Keywords**— Dolichos, PCV (Phenotypic coefficient of variation), GCV (Genotypic coefficient of variation), Heritability, GAM (Genetic advance as percent of mean).**

I. INTRODUCTION

Dolichos bean (*Lablab purpureus* L.), also known as Indian bean, it is a self-pollinated, leguminous crop grown throughout the country. It is commonly known as sem, avare, seim, bean, lablab bean, Egyptian kidney bean, Indian bean, bataw, and Australian pea in a different part of the world**.** It is cultivated as an annual crop but potentially an herbaceous perennial, erect, bushy, or climbing race type. Dolichos is primarily grown as green pods, and the dried seed are being used for vegetable purposes. It is a rich source of protein, minerals and vitamins (Golani *et al*., 2007). Its leguminous nature allows for food, forage, soil improvement, soil protection, and weed control (Maass, 2006). Due to the presence of therapeutic agents in Dolichos, it is used for traditional medicine systems and modern design (Morris 2009).

In India the young green pods and tender beans are used as vegetables and dry seeds used to prepare curry and dal. It is also well known for its use as green manure and produces edible young pods, leaves, and flowers (Morris 2003). India being the center of origin for dolichos there is an excellent range of variability for plant and pod characters of pole and bush types dolichos bean. We can exploit this variability for the development of high-

yielding dolichos genotypes. Dolichos bean had been controlling due to its photosensitive nature, irregular flowering pattern, growth habit, consumer preferences based on pod shape, size, color, the aroma of pods, and mainly low productivity (Mishra *et al.*,2019).

The evaluation of the potentialities of the existing varieties is essential because it is the genetic diversity of the initial parental material, which depends on the promise for further crop improvement. Breeding for yield and its contributing characters for any crop is controlled by environmental influence, polygenes and determined by the magnitude and nature of their genetic variability.

The exploitation of genetic variability in Dolichos bean in germplasm is a prerequisite for selecting and developing potential high-yielding genotypes. The extent of variability is measured by Genotypic coefficient of variance (GCV) and Phenotypic coefficient of variance (PCV), which also provides information about relative variation in different characters. Hence, to have a rigorous, comprehensive idea, it is necessary to have an analytical assessment of yield components.

The estimation of heritability indicates the extent to which a character is transmitted from parent to progeny. Lesser degree environment interactions influence highly heritable characters associated with yield and yield-related traits and an output indicator in the selection program. Heritability gives information on the magnitude of inheritance of quantitative characteristics, while genetic advance aids in formulating suitable selection procedures. When heritability is studied along with genetic advances, it increases the selection intensity. Considering the actual prospect, acquired the present investigation to estimate the extent of genetic variability, heritability, genetic advance for different characters in 6 Dolichos bean genotypes, and two local checks.

II. MATERIAL AND METHODS

The research work was conducted at UAS, GKVK, Bengaluru, during *rabi* 2020 to identify high-yielding Dolichos bean genotypes. The experimental material comprised six genotypes obtained from AICRP on vegetable crops, Varanasi, and two check varieties collected from UAS, Bengaluru (Table 1). The experiment was conducted in Randomized Complete Block Design (RCBD) with three replications. Selected healthy and bold seeds were sown in 4m × 4m plots with 30 cm plant to plant and 45 cm row to row spacing. Followed all recommended agronomic practices to raise a good uniform crop. Five random plants were selected from each plot to record the morphometric traits *viz* days to 50% flowering, plant height (cm), branches plant^{-1}, petiole length (cm), leaf length (cm), leaf width (cm), pod length (cm), pod width (cm), number of pod plant-1, number of seeds pod-1, green pod yield plant^{-1} (cm) and green pod yield (t/ha).

Recorded a morphological observation like plant type, leaf shape, leaf color, pod characters, and purpose of green pods and seeds use during maturity stage were also recorded from 5 random plants selected from each plot.

Analysis of variance was done to partition the total variation into variation due to treatments and replications according to the procedure given by Panse and Sukhatme (1953). Phenotypic and genotypic variance was done according to the formula given by Burton and Devane (1953). Heritability and genetic advance as *percentage* of mean were obtained by the formula given by Johnson *et al*. (1955). Statistical analysis was performed with SPSS Version 11.0 statistic software package.

Table.1 Sources of Dolichos bean genotypes used for the study

Sl. No.	GENOTYPES	SOURCE
1	DOLBVAR-2	AICRP, Varanasi
2	DOLBVAR-3	AICRP, Varanasi
3	DOLBVAR-4	AICRP, Varanasi
4	DOLBVAR-5	AICRP, Varanasi
5	DOLBVAR-6	AICRP, Varanasi
6	HA 5	UAS, Bengaluru
7	HA 3*	UAS, Bengaluru
8	HA 4*	UAS, Bengaluru

*Local checks used for the study

III. RESULT AND DISCUSSION

In the present study analysis of variance (ANOVA) for the six genotypes and 2 local checks of dolichos beangenotypes were evaluated and remarkable significant variation was observed for all 12 yield and yield attributing traits under trial (Table 2).Based on the mean performance of thegenotypes and checks, days to 50% flowering ranged from 36.50- 39.00 days with mean value 37.50 days. Earlier flowering was observed for the check variety HA 4 (36.50 days) while maximum days of 50% flowering recorded for DOLBVAR-5 (39.0 days). The genotype DOLBVAR-4 (52.80cm) was recorded the longest plant height and DOLBVAR-3 (47.20 cm) was found to be the shortest plant among all genotypes. Maximum branches plant^{-1} was recorded in DOLBVAR-3 (4.70) followed by DOLBVAR-2 (4.60). Highest number

of pods plant^{-1} was identified in the check variety HA 4 (68.73 g) followed by DOLOVAR-2 (60.80 g) and HA 5 (60.60 g). Genotype DOLBVAR-2 recorded maximum number of seeds pod^{-1} (5.8) followed by DOLBVAR-4 (5.6). Among all genotypes DOLBVAR-2 (138.73g) recorded highest green pod yield plant^{-1}followed by DOLBVAR-4 (126.13g) and HA 5 (124.33g).Green pod yield tons hectare^{-1} was maximum for genotype DOLBVAR-2 (3.90 t/ha) followed by HA 5 (3.60 t/ha) and DOLBVAR-3 (2.74 t/ha). Whereas DOLBVAR-5 (2.00 t/ha) yielded lowest among all the genotypes.

Longest petiole length was observed for DOLBVAR-5 (15.0cm) followed by HA 3 (13.0 cm), DOLBVAR-6 and HA 3 (11.0 cm) recorded the shortest petiole. Leaf length was maximum for DOLBVAR-4 and HA 5 (9.83cm) and short leaf was observed in check variety HA 3 (6.16 cm) followed by DOLBVAR-6. Broad shape leaf was observed for the genotypeDOLBVAR-4 (8.66cm) followed by HA 5 (7.69 cm).Longest pod was observed for DOLBVAR-4 (12.08cm) and DOLBVAR-3 (4.72cm) recorded the shortest pod among all genotypes and checks. The genotype DOLBVAR-2 (3.62 cm) had maximum pod width while minimum was observed for DOLBVAR-3 (1.4cm).

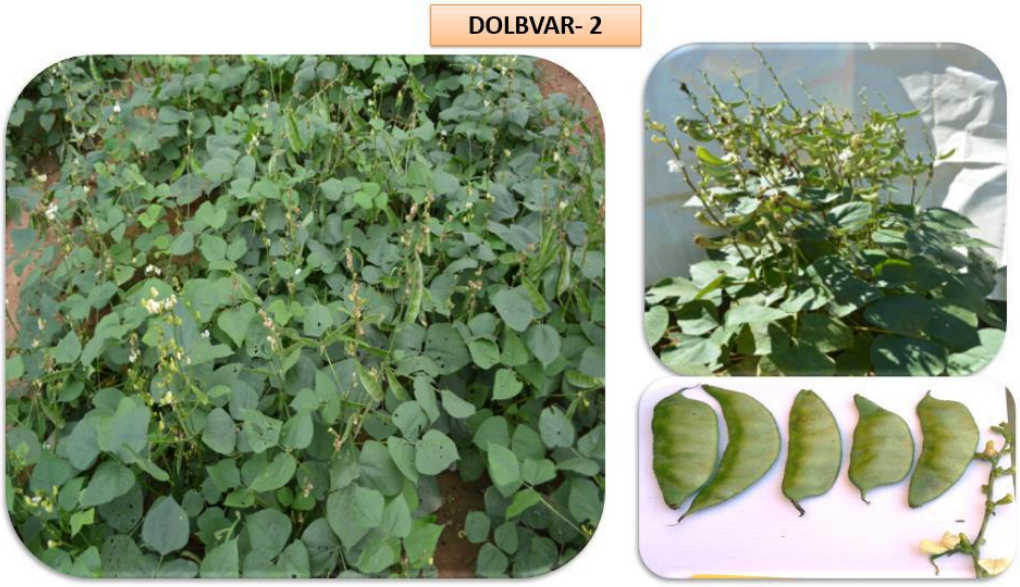

Fig 1: Genotype DOLBVAR-2

Genetic variability, heritability and genetic advance

The genetic parameters *viz*. mean, range, phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV), heritability estimates, and predicted genetic advance as *percent* of mean for characters studied are presented in Table 3 and fig 2. The trait shows a more negligible difference between PCV and GCV values was minimum, indicating that these traits are less influenced by the environment and demonstrates a high degree of genetic variability present in these characters and thus a greater scope for selection based on those characters. The estimates of various genetic parameters are given in table 3. High PCV and GCV were observed for a number of pods plant^{-1}, pod length (cm), and pod width (cm), indicating the higher magnitude of variability for these traits and consequently more scope for their improvement through selection.

Present findings were confirmed with Singh *et al.*,2015 for number of pods per plant and pod yield in 24 genotypes of Dolichos bean; Dewangan *et al*. 2017 also reported high GCV and PCV for pod width, pod weight, pod length, and green pod yield plant^{-1} in 38 Dolichos genotype. Shilpa *et al.*, 2020 also reported the same findings for pod length and pod width in 30 Dolichos genotypes.

PCV and GCV estimates were moderate for grain yield plant^{-1}(g), petiole length (cm), leaf length (cm), leaf width (cm), and a number of seeds plant^{-1}. This implied equal importance of additive and non-additive gene action for the traits recorded. These results were confirmed with the findings of Chaitanya *et al.*, 2014; Verma *et al.*, 2015; Hadavani *et al*. 2018; Susant and Bahadur, 2018; for a number of seeds pod-1 in Dolichos bean.

Low GCV and PCV were recorded for days to 50% flowering, number of primary branches plant-1, and plant height (cm). These results confirmed the findings of Chaitanya *et al*., 2015 for days to 50% flowering and plant height in 34 pole

type Dolichos bean genotypes. Savithiri *et al.*, 2018 also reported similar findings for days to first flowering and days to 50 percent flowering in 60 genotypes of Yard Longbean.

In the present study, high heritability coupled with high genetic advance as *percent* of mean was recorded for all the characters except for days to 50% flowering, number of primary branches plant-1, and for plant height (cm). The results indicate these characters are under the influence of additive gene action; hence simple selection based on the phenotypic performance of these traits would be more effective. Present results were similar to the findings of Rai *et al*. 2006 and Savitha (2008) for pod length, pod width, number of seeds pods^{-1}; Magalingam *et al*., 2014 reported similar result for pod length (cm) and pod width (cm), pod weight (g) in Dolichos bean genotypes and Kujur *et al.*, (2017 for days to first flowering, pod length (cm) and pod width (cm) in Dolichos bean.

High heritability with low genetic advance as *percent* mean values were observed for the characters days to 50% flowering, number of primary branches plant^{-1} and plant height (cm); this indicates the influence of non-additive gene action considerable influence of environment on the expression of these traits. These traits could be exploited through the manifestation of dominance and epistatic components through heterosis.

Study of plant type, leaf, and pod characters for the eight Dolichos genotypes

A detailed morphological study for plant type, leaf, and pod characters was done, and findings were recorded and represented in table 4 and figure 3. All the entries used for the experiment were the bush type with ovate-shaped green-colored leaves. Genotype DOLBVAR-2 and DOLBVAR-4 exhibited flat and long dark green pods, among which the pod DOLBVAR-2 was the longest. The pods were fleshy, and the whole pod could be eaten as a vegetable. Among all the DOLBVAR genotype, DOLBVAR-3 had whitish pods and smaller in size. The pods were dried to be used for seed purposes. DOLBVAR-4 and DOLBVAR-6 were tall and slender in shape, as their width was less. The pods of these genotypes could be eaten as a whole green vegetable.

Table 2. Mean performance for yield and yield attributing traits in 6 genotypes and two check varieties of Dolichos bean

S.No.	Genotypes	Days to 50% flowering (Days)	Plant height (cm)	Branches/plant	Petiole length (cm)	Leaf length (cm)	Leaf width (cm)	Pod length (cm)	Pod width ( )	No. of pods/plant	No. of seed/ pod	Green pod yield/ plant (g)	Green pod yield (t/ha)
1	DOLBVAR-2	37.50	50.70	4.60	13.1	8.0	6.13	12.08	3.62	60.80	5.8	138.73	3.90
2	DOLBVAR-3	36.50	47.20	4.70	12.3	9.33	5.40	4.72	1.40	47.20	5.0	121.33	2.74
3	DOLBVAR-4	38.50	52.80	4.50	12.0	9.83	8.66	11.22	1.90	49.26	5.6	126.13	2.80
4	DOLBVAR-5	39.00	51.80	4.40	15.0	8.12	7.02	8.10	2.04	44.93	5.0	106.20	2.00
5	DOLBVAR-6	37.50	49.30	4.55	11.0	6.33	6.64	8.20	1.86	47.46	3.8	119.26	2.64
6	HA 5	37.00	50.80	4.20	13.0	8.89	7.69	6.00	1.90	60.60	4.4	124.33	3.60
7	HA 3*	37.50	49.30	4.30	11.0	6.16	6.43	6.20	1.88	60.26	4.4	103.40	2.18
8	HA 4*	36.50	51.30	4.00	10.42	9.83	6.96	4.60	1.72	68.73	4.2	112.80	4.00
	MEAN	37.50	50.40	4.41	12.22	8.31	6.87	7.64	2.04	54.91	4.78	119.02	2.98
	SE m ±	0.38	2.61	0.15	0.47	0.47	0.14	0.26	0.13	2.59	0.11	3.57	0.16
	CD @ 5%	1.24	8.73	0.50	1.56	1.56	0.47	0.88	0.43	8.67	0.36	11.93	0.52
	CV (%)	1.44	7.33	4.81	5.20	5.20	2.79	4.64	8.72	6.69	3.16	4.12	8.04

Table 3. Estimation of genetic parameters for 12 characters in 6 Dolichos bean genotypes and check varieties

Characters	Mean	Range	GCV (%)	PCV (%)	Heritability (%)	Genetic advance	Genetic advance as % of mean
Days to 50% flowering (Days)	37.5	34.5-39.0	3.58	3.86	86.09	2.54	6.85
Plant height (cm)	50.4	47.20-52.80	5.38	6.71	64.28	4.53	8.88
No. of branches/plant	4.41	4.00-4.70	3.98	6.24	40.61	0.23	5.22
Petiole length (cm)	12.2	11-12.3	12.81	13.83	85.86	3.10	24.46
Leaf length (cm)	8.31	6.16-9.83	13.78	16.22	72.11	2.04	24.10
Leaf width (cm)	6.87	5.4-8.66	14.52	14.79	96.44	2.09	29.38
Pod length (cm)	7.64	6.0-12.08	36.04	36.34	98.37	5.88	73.64
Pod width (cm)	2.04	1.4-3.42	27.21	28.58	90.69	1.12	53.39
No. of pods/plant	59.2	42.25-76.30	23.38	24.32	92.43	25.39	46.31
No. of seed	4.78	3.8-5.8	14.59	14.93	95.53	1.42	29.38
Green pod yield/ plant (g)	82.9	97.45-168.00	19.79	20.22	95.85	48.86	39.92
Green pod yield (t/Ha)	2.75	1.45-4.32	39.6	40.41	96.04	2.20	79.94

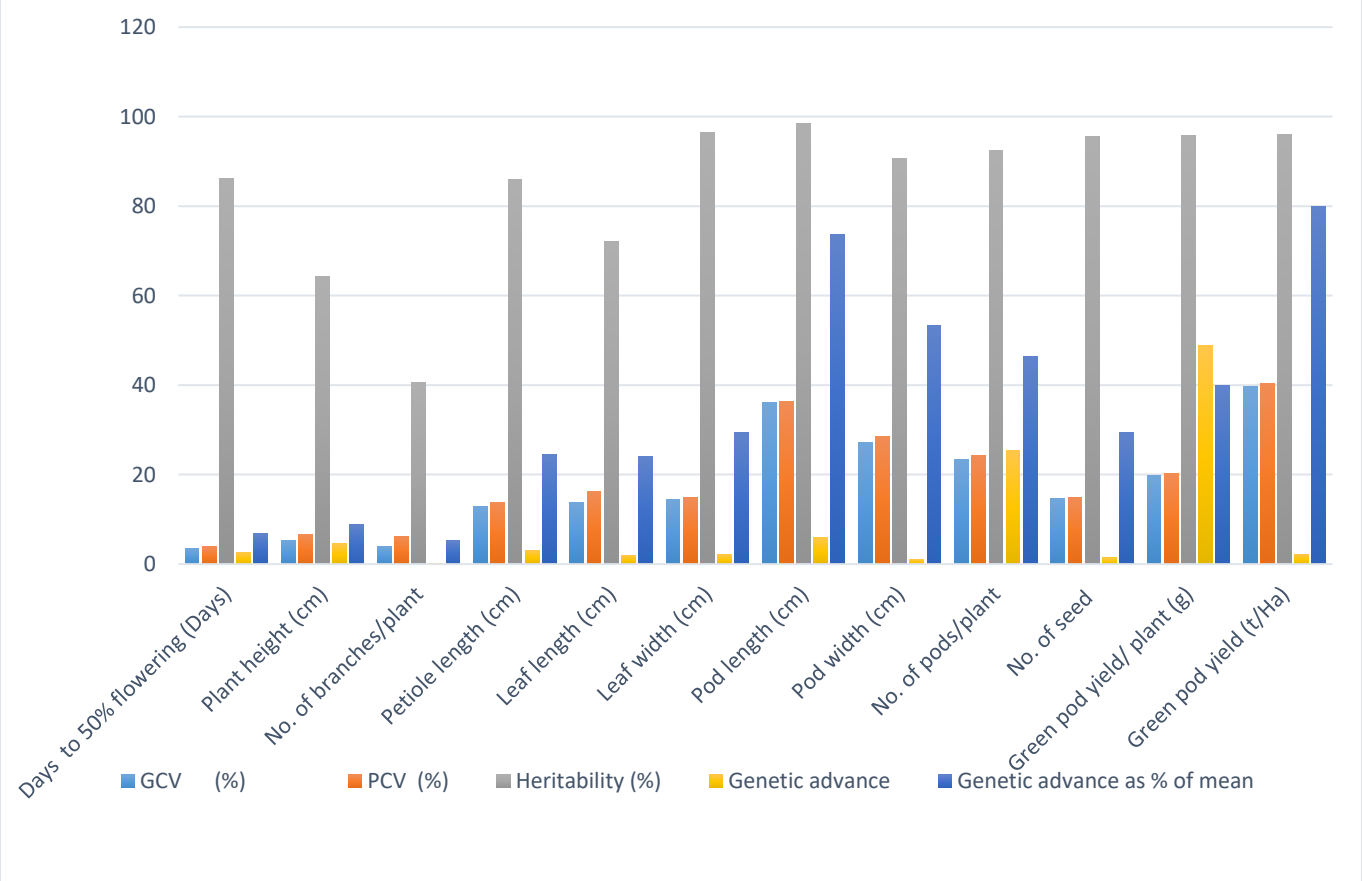

Fig 2: Graphical representation of genetic parameters for 12 characters in 6 Dolichos bean genotypes and check varieties

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Table.4: Leaf and pod characteristics of Dolichos bean genotypes and checks

Genotype name	Bean type	Leaf shape	Leaf color	Pod character	Purpose
DOLBVAR-2	Bush	Ovate	Green	Flat and long, Dark green	Used as whole for vegetable purpose
DOLBVAR-3	Bush	Ovate	Green	Flat and short, whitish green	Used as seed purpose
DOLBVAR-4	Bush	Ovate	Green	Flat and long, dark green	Used as whole for vegetable purpose
DOLBVAR-5	Bush	Ovate	Green	Medium flat, green in color	Used as whole for vegetable purpose
DOLBVAR-6	Bush	Ovate	Green	Medium flat, green in color	Used as whole for vegetable purpose
HA 5	Bush	Ovate	Green	Light green in color	Used as seed purpose
HA 3*	Bush	Ovate	Green	Dark green on the ridges	Used as seed purpose
HA 4*	Bush	Ovate	Green	Light green and dark green on the ridges	Used as seed purpose

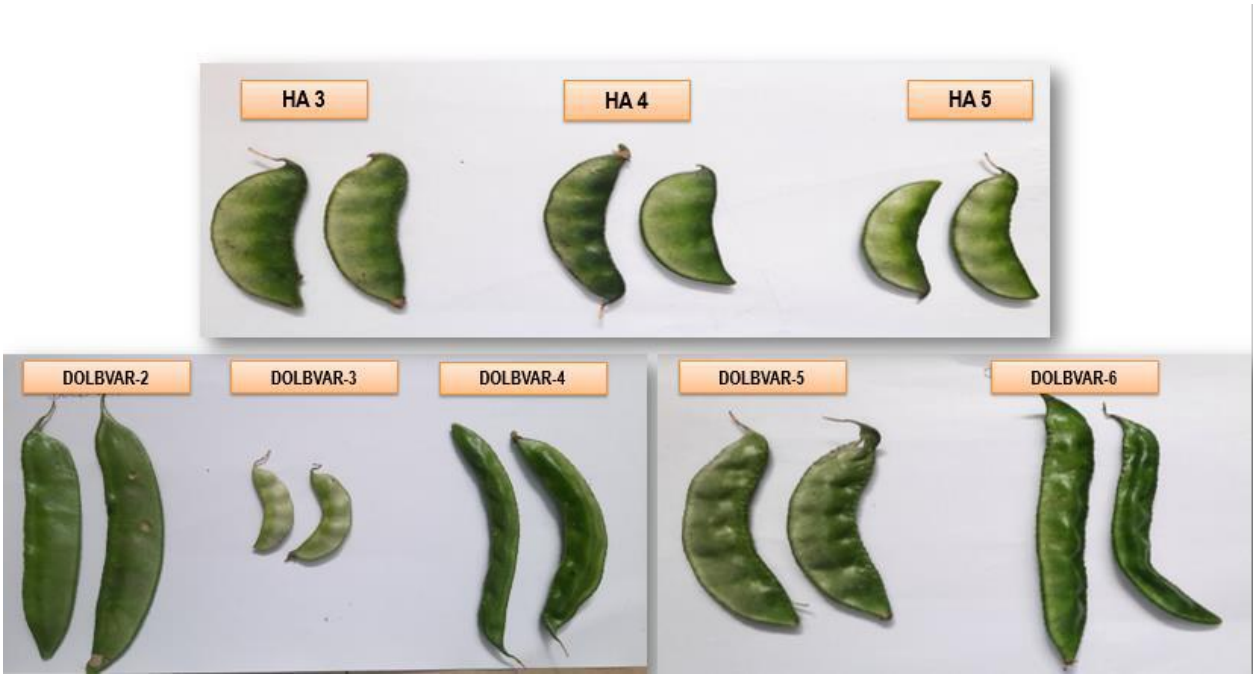

Fig 3: Pod characteristics of 6 genotypes and 2 checks of dolichos bean

DOLBVAR-2 recorded the maximum number of green pods *per* plant, green pod yield plant-1, and green pod yield hec^{-1}. Even the check variety HA 4 (4.00 t/ha) is on par with DOLBVAR-2 (3.90 t/ha) for green pod yield *per* hectare at 5% CD value. The genotypes HA 5 (60.60) and DOLBVAR-2 (60.8) were also on par with the local checks with respect to a number of green pods *per* plant. So, it can be concluded that DOLBVAR-2

is the best performing Dolichos genotype among taken up for trial.

The genotype DOLBVAR-2 was found with the tallest pods among all the genotypes, and pods could be used as whole green vegetables.

In conclusion, based on genetic variability estimates that individual plant could be carried out selection for characters *viz*., pod yield plant^{-1}, pod length (cm), pod weight (cm) as they recorded high values of heritability coupled with high genetic advance Hence, the breeder should adopt a suitable breeding methodology to utilize both additive and non-additive gene effects simultaneously since varietal and hybrid development will go a long way in the breeding programs, especially in the case of Dolichos bean

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