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A STUDY ON MORPHO-NUTRITIONAL VARIABILITY AMONG LABLAB BEAN GENOTYPES

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ABSTRACT

To evaluate the morphological and nutritional variability among six lablab bean (*Lablab purpureus*L.) genotypes, a study was carried out at Sylhet Agricultural University, Bangladesh and at Bangladesh Agricultural Research Institute (BARI) during mid-July 2014 to mid-March 2015. Significant morphological variations were noted in both seedling and vegetative stages in their growth. In addition, there were three distinct flower and flower wings color viz. white in SB003; violet in SB010, Rupvan, Auto, and Kanchan; and light violet in SB011 were noted among the genotypes. Further, 8 or 9 layers of flower wings were observed among the genotypes and the inflorescence length varied from 46.40 cm (SB011) to 42.40 cm (SB010). Considering the pod characteristics, pod length and breadth varied from 14.13 cm (SB011) to 8.13 cm(SB010), and 2.68 cm (Auto) to 2.43 cm (SB010), respectively. Significant variations were also noted for pod yield characteristics. The genotype of Kanchan had the highest number of pod/plant (202.7), whereas Auto had the highest pod yield (23.05 t/ha) followed by Kanchan (19.26 t/ha).The study also revealed that pod yield (t/ha) was positively correlated with the number of pods/plant (0.71), pod weight/plant (1.00), individual pod weight (0.65) and pod yield/decimal (1.00) among the genotypes. Furthermore, significant variations were also noted for the nutrient compositions among the genotypes. The analytical experiment shows that Auto had the highest proportion of Cu (15.28 ppm), Fe (122.22 ppm), Mn (40.74 ppm), B (60.60 ppm), S (0.158 %) and Ca (1.67%). In contrast, the genotype of SB003 had the highest amount of Zn (61.86 ppm) and SB011 had Mg (785 %) content. Therefore, the genotypes of Auto and Kanchan would be recommended for cultivation in the Sylhet region of Bangladesh.

Keywords: Morphology, nutrition, pod character, yield, bean genotypes..

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INTRODUCTION

Lablab bean (*Lablab purpureus*(L.) sweet; hitherto *Dolichos lablab*) is one of the major winter vegetables of Bangladesh. It is commonly known as country bean and is widespread throughout the country. Among the Lablab bean growing countries, Bangladesh, India, Malaysia, Indonesia, Philippines, Papua New Guinea, China, Japan, Australia; north, south and east Africa; the Caribbean, south and central America are the most noteworthy (Lelei et al., 2009). Lablab bean is a multipurpose crop grown for pulse, vegetables and forage (Mir et al., 2004 & Tefera et al., 2006). It is used as vegetables for its green pods, while dry seeds are used in various food preparations (Sultana, 2001). The plant is variable with regard to vines, leaves, inflorescence, pods, seeds and nutrition among the cultivars as a result of extensive breeding (Islam, 2008). Morphological characterization of lablab beans shows high heritability, which can be distinguished by naked eyes. Characterization should provide a standardized record of readily assessable plant characters, which go a long way to identify an accession. Its green pod provides considerable amount of protein in addition to vitamins and minerals (Gopalan et al., 1982; Aykroyd, 1963). One hundred grams of young pods contain 83% water, 4.50 g protein, 10.00 g carbohydrate, 1.00 g fat, 2.00 g fiber, 0.05 mg thiamin, 0.01 mg riboflavin and little amount of vitamin C. The dry seed contains 8% water, 25.00 g protein, 60.00 g carbohydrate, 0.80 g fat, 1.40 g fiber, 100 International unit (IU) of vitamin A, 0.50 mg thiamin, 0.10 mg riboflavin, 1.80 mg niacin and slight amount of vitamin C (Rashid, 1976). The lablab bean is available in the market of the Sylhet region during winter months, when a lot of winter vegetables are also vaailable; however, it could be cultivated all the year round due to its photo and/or thermo-sensitive behavior. Therfore, considering it as a rich source of protein, vitamins, and minerals, suitable genotypes need to be selected for this region to ensure food and nutrition security as well as livilihood improvement. This would also help to explore the export potentials of lablab bean after meeting local demand. The Sylhet Agricultural University developed some inbred lines maintaining some popular lablab bean lines for further improvement (Roy, 2013).However, their morphological database as well as determination of nutritional status is yet to be done. Considering all the above facts, the present investigation was planned to characterize and to determine the nutritional value of different lablab bean genotypes.

METHODOLOGY

The investigation was performed at the experimental field of the Sylhet Agricultural University and at the laboratory of BARI during mid July 2014 to mid-March 2015 to characterize and to determine nutritional values of six lablab bean genotypes. The experiment was conducted in RCB design with three replications. Seeds of each of the six genotypes (viz. SB003, SB010, SB011, Auto, Rupvan and Kanchan) were sown in polybag on 15 July 2014 for both pod production and to determine the nutritional values in lablab beans. The unit plot size was 1.5 m × 6.0 m accommodating six plants per bed. The land was fertilized with well decomposedcowdung, urea, TSP and MoP @ 10 ton, 50 kg, 150 kg and 150 kg per hectare, respectively (Rashid, 1999). Entire amount and cowdung, TSP and half of the MoP were appliedat pit preparation, while rest of urea and MoP were applied at 15 and 30 day after

transplanting. Plants were spaced at 1.0 m in a bed and 2.0 m between two adjacent beds. Distances of 50 cm in the form of drain between the blocks and between the beds within a block were maintained. Pits of 50 cm ×50 cm × 50 cm were prepared 15 days before transplanting of seedlings. The pit soil was prepared by mixing basal dose of manure and fertilizers in such a way that the pit tops remained at least 10 cm above the ground level to facilitate drainage. Fifteen days old seedlings were transplanted in the main field followed by watering for establishment of the seedlings and finally, one healthy seedling was allowed to grow in each pit. For climbing of the plants, bamboo made staking was given in each bed.Weeding, irrigation, mulching and other intercultural operations were performed as and when necessary. Data were recorded from each bed on morphological parameters, yield and yield attributes as well as nutrient contents and analyzed using MSTAT software for interpretation of the results.

Estimation of correlation co-efficient: Association of different characters under the study was analyzed by working out simple correlation coefficient for all the possible pairs of character combinations. Simple correlation coefficient (r) among the yield and yield contributing characters of lablab bean genotypes was estimated with the following formula (Singh and Choudhury, l985).

$$r = \frac{\sum xy - \frac{\sum x \sum y}{N}}{\sqrt{\left\{\sum x^2 - \frac{(\sum x)^2}{N}\right\}\left\{\sum y^2 - \frac{(\sum y)^2}{N}\right\}}}$$

Where,

Σ = summation

x and y are the variables correlated

N = number of observations

Nutrient analysis: Six lablab bean genotypes were analyzed to determine the nutritional values. Fresh pods were taken for oven drying and the dried pods were analyzed for nutritional values at thelaboratory of Soil Science, Divisionof the Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur**.**

RESULTS & DISCUSSION

Seedling characteristics:Significant variation was observed for seedling characteristics among six lablab bean genotypes (Table 1). Two types of cotyledon color were notedvisually among thegenotypes. Light green cotyledons were observed among all genotypes except SB003. The cotyledon color in the genotype of SB003 was green. There were two types of hypocotylscolor found among the genotypes. Hypocotyls color of SB003, SB010 and Auto were white, while SB011, Rupvan and Kanchan were light green. The highest terminal leaf length was found in Rupvan (10.4 cm)followed by the genotypes of Auto (9.73 cm), SB003 (9.56 cm), Kanchan (9.53 cm) and SB010 (9.13 cm), while the lowest terminal leaf length

was found in the genotype SB011 (9.0 cm). Thehighestterminal leaf breadth (9.26 cm) was observedin Rupvan followed by the genotypes SB003 (8.75 cm), SB011 (8.30 cm), SB010 and Kanchan (8.06 cm). On the other hand, the lowestterminal leaf breadth (8.03 cm) was observed in Auto.Only green vein color of primary leaves was noted among six genotypes. Two types of leaflet shapesviz. round and oval were found among the genotypes. Leaflet shape of SB010 and Auto were oval, while it was for SB003, SB011, Rupvan and Kanchan were round. These results were supported with few previous experiment performed by Islam (2008) and Sultana (2001). Islam (2008) recorded green and whitecotyledonsas well as white and purple hypocotyls in 44 genotypes of hyacinth bean. Sultana (2001) also recorded only green and purple vein color of primary leaves among 107 lablab bean genotypes.

Table 1. Seedling characteristics of lablab bean genotypes

Genotypes	Cotyledon Color	Hypocotyl color	Terminal leaf length (cm.)	Terminal leaf breadth (cm.)	Vein color of primary leaves	Leaflet shapes
SB003	Green	White	9.56	8.75ab	Green	Round
SB010	Light green	White	9.13	8.06b	Green	Oval
SB011	Light green	Light green	9.0	8.30b	Green	Round
Rupvan	Light green	Light green	10.4	9.26a	Green	Round
Auto	Light green	White	9.73	8.03b	Green	Oval
Kanchan	Light green	Light green	9.53	8.06b	Green	Round
F-test	-	-	ns	*	-	-
CV%	-	-	5.52	5.45	-	-

* Significant at 5% level of probability; ns= non-significant.

Vegetative characteristics: Consideringthe vegetative characteristics, only green color leaveswere observed among the genotypes. Localized pigmentation to nodes was observed in the genotypes SB010 and SB011, whereas it was for Rupvan was slightly violet; and SB003, Auto and Kanchan showed no pigmentation to nodes.The highest top internode length was found in the genotypes SB003 (14.50 cm) followed by Kanchan (13.63 cm), Auto (13.57 cm), Rupvan (13.50 cm) and SB011 (12.67 cm). In contrast, the lowest top internode length (12.37 cm) was observed for the genotype of SB010. Further, little variation in petiole length ranged from 9.75 cm (SB010) to 14.10 cm (Rupvan) was noted for the genotypes**(Table 2)**.

Table 2. Vegetative characteristics of lablab bean genotypes

Genotypes	Leaf Colors	Main stem pigmentation	Top internode length (cm.)	Petiole length (cm.)
SB003	Green	No pigmentation	14.50a	11.10b

SB010	Green	Localized to nodes	12.37c	9.75b
SB011	Green	Localized to nodes	12.67bc	10.43b
Rupvan	Green	Slightly violet	13.50abc	14.10a
Auto	Green	No pigmentation	13.57abc	10.48b
Kanchan	Green	No pigmentation	13.63ab	11.80ab
F-test	-	-	*	**
CV%	-	-	5.15	9.66

Inflorescence characteristics: Significant variation in the inflorescence were noted among the genotypes**(Table 3)**.Flower color is one of the important characteristics to distinguish the genotypes. Three distinct flower colors were observedin the genotypes of lablab beans. White flower was identified only in the genotype of SB003 and violet flowers were observed in the genotype SB010, Rupvan, Auto, and Kanchan. On the other hand, slightly violet color flower was noticed in the genotype of SB011.Considering the flower wings, white color flower was observed only in the genotype SB003, while violet flowers were observed in the genotypes of SB010, Rupvan, Auto, and Kanchan. On the other hand, slightly violet flower was found in the genotype of SB011.There were little variation was noticed in the days to first floweringranged from 51 days to 55 daysamong the genotypes. Maximum days were required for the genotype of SB003 (55 days) followed by Kanchan (54 days),Rupvan and Auto (52 days) andminimum daysfor the first floweringwere required for the genotypes of SB010 and SB011 (51 days). Considering thelayers of flower wings, two types of layerwere observed among the genotypes. The highest layer of flower wings werenoted for the genotypes of SB003, SB010 and Rupvan (9 layers);whereas,the lowest layer of flower wings were observed in the genotypesof SB011, Auto and Kanchan (8 layers).Further, strong significant difference was observed for inflorescence length among the genotypes. The highestinflorescence length was recorded in the genotype of SB011 (46.40 cm) followed by Rupvan (45.37 cm), Kanchan (44.37 cm), Auto (44.23 cm) and SB003 (43.90 cm) and the lowest inflorescence length was recorded for the genotype of SB010 (42.40 cm).

Table 3. Inflorescence characteristics of lablab bean genotypes

Genotypes	Flower color	Color of flower wings	Days to first flowering (days)	Layer of flower wings	Inflorescence length(cm.)
SB003	White	White	55	9	43.90bc
SB010	Violet	Violet	51	9	42.40c
SB011	Slightly violet	Slightly violet	51	8	46.40a
Rupvan	Violet	Violet	52	9	45.37ab
Auto	Violet	Violet	52	8	44.23bc
Kanchan	Violet	Violet	54	8	44.37b

F-test	-	-	Ns	Ns	**
CV%	-	-	3.39	10.30	1.65

Pod characteristics: Considering the pod characteristics, the pod color of the genotype SB003 was observed deep green, while it was light green forthe genotypes of SB010 and Kanchan. The genotypes of SB011 and Auto had green color pod and slightly reddish pod was observedonly in the Rupvan. Variations were also noted with respect to pod curvature among these genotypes; only curved pod was observed in the genotype of SB003, whereas slightly curved pod were notedamong rest of the genotypes.Considering pod beak shape of the genotypes,thick beaked pod was observed in the genotypes of SB003, SB010 and Auto, while, short beak shape of pod was found in rest of the genotypes viz. SB011, Rupvan and Kanchan. Therefore, it can be said thatthere were 50% short beaked- and 50% thick beaked pods.Considering the pod length, SB011 produced the longest pod (14.13 cm) followed by the genotypes SB003 (11.07 cm), Auto (10.92 cm), Rupvan (8.83 cm) and Kanchan (8.60 cm). However, the shortest pod length was recorded in the genotype of SB010 (8.13 cm). The significantvariation was observed among the genotypes in pod breadthwas ranged from 2.43 cm to 2.68. The genotype of Auto had the longest pod breadth (2.68 cm) followed by SB011and Rupvan (2.51 cm) as well as SB003 and Kanchan (2.50 cm),whereasthe shortest pod breadth (2.43 cm) was recorded for the genotype of SB010**(Table 4)**. These findings were supported by the results of the study performed by Sultana (2001), where it was reported that most of the accessions showed green pods color followed by mixed color of green and violet as well as white pods with purple margin. Islam (2008) also recorded green, light green, mixed color (green with red or purple ridge) and red purple pods; straight, slightly curved and curved pods; andmost of the genotypes showed thick beak followed by long beak and medium length beak and only few genotypes produced pod with short beaked shape. Pengelly & Maass (2001) reported the pod length ranged from 2.5 to 14.0 cm and pod breadth ranged from 1.6 cm to 3.2 cm among 249 genotypes. Similar variation with respect to pod length was also reported by Mollah *et al.* (1995) and Sultana (2001).

Table 4. Pod characteristics of lablab bean genotypes

Genotypes	Pod color	Pod curvature	Pod beak shape	Pod length (cm.)	Pod breadth (cm.)
SB003	Deep green	curved	Thick beak	11.07b	2.50b
SB010	Light green	Slightly curved	Thick beak	8.13c	2.43b
SB011	Green	Slightly curved	Short beak	14.13a	2.51b
Rupvan	Slightly reddish	Slightly curved	Short beak	8.83c	2.51b
Auto	Green	Slightly curved	Thick beak	10.92b	2.68a

Kanchan	Light green	Slightly curved	Short beak	8.60c	2.50b
F-test	-	-	-	**	*
CV%	-	-	-	4.34	2.80

Pod yield characteristics: Significant variation for pod yield characteristics was noted among the genotypes **(Table 5)**. The highest number of pod/plant (202.7) was found in the genotypeof Kanchanfollowed by SB010 (162.3), Rupvan (134.3), Auto (131.7) and SB003 (97.33), while the lowest number (53.67)was recorded for the genotype of SB011.The genotypes differed significantly for individual pod weight ranged from 6.8 g to 18.2 g. The highest individual pod weight was recorded from Auto (18.2 g)followed by Kanchan (9.6 g)and thelowest pod weight was recorded from the genotype SB010 (6.8 g). The number of green seeds per pod varied from 4.2 to 4.6. Among the genotypes, SB011 (4.6) produced the highest number of green seeds per pod followed by SB003 (4.5), SB010 (4.5), Kanchan(4.5) and Auto(4.3) and the lowest number of seeds per pod was produced for the genotypeof Rupvan (4.2). Days to first harvest varied slightly from 75.0 to 76.66 days. The genotypes of SB011 and Rupvan were harvested at 75.0 days followed by the genotypes of SB010 (75.33 days), Auto (76.0 days), Kanchan(76.0 days) and SB003 (76.66 days). The highest pod weight per plant was calculated for Auto (1.50 kg.) followed by the genotypeof Kanchan (1.25 kg.), Rupvan (1.12 kg), SB010 (0.86), SB003 (0.67) and SB011 (0.35), whereasthe lowest pod weight per plant was recorded for the genotype of SB011 (0.35 kg).Considering the harvest duration, maximum days were required for the genotype of SB003 (100.66 days) followed by SB010 and Auto (100.33 and 100.33 days, respectively). In contrast, the lowest harvest duration was recordedfor the genotype of Kanchan (98.66 days).The significant variation in pod yield per decimalvaried from 21.98 to 93.33 kg was observed among the genotypes. The highest pod yield per decimal was recorded for Auto (93.33 kg) followed by the genotype Kanchan (77.98 kg). The lowest pod yield per decimal was observedin the genotype SB011 (21.98 kg). These results were supported by the findings of Khan (2003). Islam (2008) also recorded the harvest duration ranged from 50 days to more than 90 days among different genotypes of lablab beans.

Table 5. Pod yield characteristics of lablab beangenotypes

Genotypes	No. of pods/ plant	Individual pod weight (g)	No. of green seeds/pod	Days to first harvest	Weight of pods /plant (kg)	Harvest duration (days)	Pod yield/decimal (kg)
SB003	97.33d	9.0bc	4.5	76.66	0.67e	100.66	41.68

SB010	162.3b	6.8e	4.5	75.33	0.86d	100.33	53.50
SB011	53.67e	8.2cd	4.6	75.0	0.35f	99.33	21.98
Rupvan	134.3c	7.9d	4.2	75.0	1.12c	99.0	69.68
Auto	131.7c	18.2a	4.3	76.0	1.50a	100.33	93.33
Kanchan	202.7a	9.6b	4.5	76.0	1.25b	98.66	77.98
F-test	**	**	Ns	ns	**	Ns	**
CV%	1.74	4.14	6.56	1.88	1.12	1.93	2.5

Pod yield (t/ha): The influence of genotypes on pod yield was statistically significant. The highest pod yield was recorded from the genotype of Auto (23.05 t/ha) followed by Kanchan (19.26 t/ha) **(Figure 1)**. The lowest pod yield was observed in the genotype of SB011 (5.42 t/ha). The pod yield of other genotypes wereSB003 (10.29t/ha), SB010 (13.21t/ha) and Rupvan (17.21t/ha). This yield variation among the genotypes might be due to inherent potentials of the genotypes. Halim and Ahmed (1992) reported the yield of nine country bean lines ranging from 7.20-12.52 t/ha, while Mollah *et al.* (1995) observed yield variation of nine hyacinth beans 9.4-21.4 t/ha.

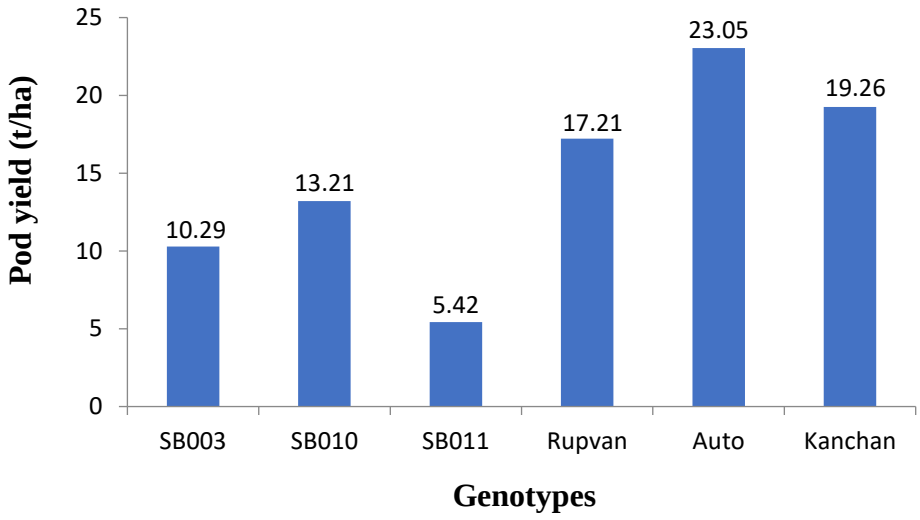

Figure 1. Pod yield (t/ha) of lablab bean genotypes

Relationship between pod yield and yield contributing characters: Correlation between pod yield and yield contributing characters revealed that pod yield (t/ha) was positively correlated with the number of pods per/plant (0.71), weight of pods/plant (1.00), individual weight of pod (0.65) and pod yield/decimal (1.00)**(Table 6)**. The pod breadth showed non-significant positive correlation (0.47), while the pod length demonstratedthe significant negative correlated with pod yield (-0.57). In addition, the inflorescence length, layer of

wings, number of green seeds/pod showed non-significant and negative correlation with the pod yield.

Table 6. Relationship between pod yield and yield contributing characters

	Layer of wings	Number of pods/plant	Weight of pods/plant (kg.)	Pod length (cm.)	Pod breadth (cm.)	Number of green seeds/pod	Individual weight of pod (g)	Pod yield/ decimal	Pod yield (t/ha)
Inflorescences length (cm.)	-0.03^{Ns}	-0.48*	-0.38 ^{Ns}	0.60**	-0.01 ^{Ns}	0.12 ^{Ns}	-0.15 ^{Ns}	-0.15 ^{Ns}	-0.38 ^{Ns}
Layer of wings		0.01 ^{Ns}	-0.11 ^{Ns}	-0.23 ^{Ns}	-0.33 ^{Ns}	0.05 ^{Ns}	-0.28 ^{Ns}	-0.11 ^{Ns}	-0.11 ^{Ns}
Number of pods/plant			0.71**	-0.87**	-0.10 ^{Ns}	-0.13 ^{Ns}	0.04^{Ns}	0.71**	0.71**
Weight of pods/plant (kg.)				-0.57 *	0.47 ^{Ns}	-0.35 ^{Ns}	0.65 **	1.00**	1.00**
Pod length (cm.)					0.20 ^{Ns}	0.24 ^{Ns}	0.18 ^{Ns}	-0.57*	-0.57*
Pod breadth (cm.)						-0.45 ^{Ns}	0.76**	0.47 ^{Ns}	0.47 ^{Ns}
Number of green seeds/pod							-0.17 ^{Ns}	-0.35 ^{Ns}	-0.35 ^{Ns}
Individual weight of pod (g)								0.65**	0.65**
Pod yield/decimal									1.00**

Nutrient composition among the lablab bean genotypes: It was observed that the highest Cu contentwas recorded for Auto (15.28 ppm) followed by the genotype of SB011 (11.81 ppm), while it was the lowest for the genotype of Kanchan (8.60). The amount of Fe ranged from 122.22 to 68.8 ppm. The highest Fe content wasrecorded for the genotype of Auto (122.22 ppm), while it was the lowest in Kanchan (68.82 ppm). The highest amount of Mn was observed in Auto (40.74 ppm) followed by the genotypes of SB011 (31.48 ppm) and SB003 (31.36 ppm) and the lowest Mn contentwas recorded for Kanchan (22.94 ppm). The highest content of Zn was observed in the genotype of SB003 (61.86 ppm) followed by SB011 (60.30 ppm) and the lowest amount of Zn was found in the genotype of Kanchan (29.40 ppm).It was also determined thatthe highest amount of Boron (B) was recorded for Auto (60.60 ppm) followed by the genotype of SB011 (33.0 ppm). The genotype SB003 (31.20 ppm) was closely followed by SB010 (30.60 ppm) and it was for Rupvan and Kanchan was identical (25.20 ppm). The highest amount of S was observed in Auto (0.158 %) followed by the genotypes of SB011 (0.088 %), SB010 (0.073 %), SB003 (0.066 %) andRupvan (0.044 %), while it was the lowest for the genotype of Kanchan (0.038 %). It was also recorded that the amount of Ca ranged from 1.67-1.18 (%). The highest content of Ca was measured for the genotype of Auto (1.67%) followed by the genotypes of SB003 (1.61 %), SB011 (1.41 %), Kanchan (1.35 %) and SB010 (1.31 %), while it was the lowest for the genotype ofRupvan (1.18 %). The highest Mg content was observed in the genotype of SB011 (785 %) followed by SB003 (0.679 %), Kanchan (0.646 %), Auto (0.626 %), SB010 (0.605 %) and Rupvan (0.595 %), respectively**(Table 7)**.

Table 7.Mineral nutrient value of six lablab bean genotypes

Genotypes	Cu	Fe	Mn	Zn	B	S	Ca	Mg
	Ppm					%		
SB003	11.76	94.08	31.36	61.86	31.20	0.06	1.61	0.67
SB010	8.66	69.24	23.08	43.92	30.60	0.07	1.31	0.60
SB011	11.81	94.44	31.48	60.30	33.00	0.08	1.41	0.78
Auto	15.28	122.22	40.74	46.74	60.60	0.15	1.67	0.62
Rupvan	8.78	70.20	23.40	48.12	25.20	0.04	1.18	0.59
Kanchan	8.60	68.82	22.94	29.40	25.20	0.03	1.35	0.64
Mean	10.80	86.5	28.83	48.39	34.3	0.07	1.42	0.6
Range	8.60-15.28	68.82-122.22	22.94-40.74	29.40-61.86	25.20-60.60	0.03-0.15	1.18-1.67	0.59-0.78

CONCLUSION

The study concluded that the genotype Auto gave the highest pod yield potentials followed by Kanchan. Auto also gave the better result compared to other genotypes with respect to nutritional values. Therefore, Auto and Kanchan may be recommended for pod yield under Sylhet condition. Furthermore, this study also sugests that the genotypes of SB003, SB010, SB011 and Rupvan would be taken for regional yield trial for further verification.

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