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MORPHOLOGICAL CHARACTERIZATION AND EVALUATION OF CYANIDE CONTENT OF *LABLAB PURPUREUS* L. (HYACINTH BEAN)

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ABSTRACT

Lablab purpureus L. (Hyacinth bean) is an underutilized leguminous plant with notable nutritional and medicinal value commonly found in tropical regions. This study aimed to characterize the morphological traits of twenty *Lablab purpureus* accessions and to evaluate the cyanide content in six selected accessions (TLn28, TLn28-B, TLn28-A, TLn37, TLn43, and TLn52). The field experiment followed a completely randomized design with three replicates. Results revealed significant variation ($p < 0.05$) among the accessions in growth and yield traits. Accession TLn2 showed superior performance in plant height (23.82 cm) and leaf count (12.71), whereas TLn70 exhibited the highest values for leaf length (11.68 cm) and width (11.73 cm). Accession TLn37 excelled in pod count per replicate (36) and seed count per replicate (134), while TLn28, TLn11, and TLn4 demonstrated the highest values for fresh pod weight (37.00 g), pod length (8.03 cm), and pod width (2.10 cm), respectively. The cyanide content, assessed using the alkaline picrate colorimetric method, was significantly lower in TLn37 than in the other five accessions and fell well below the toxicity threshold (36 mg/100 g) for humans and animals. Consequently, accessions TLn2 and TLn70 are promising candidates for breeding and cultivation based on desirable foliar traits, while TLn37 is particularly suited as a low-cyanide planting material for safe hyacinth bean production for human and animal consumption.

KEYWORDS: Lablab purpureus, Cyanide content, Crop improvement, Morphological diversity.

INTRODUCTION

Lablab purpureus L., commonly referred to as Hyacinth bean, Dolichos bean, or Indian butter bean, is a versatile and underutilized legume species that holds considerable potential for enhancing agricultural productivity and food security in tropical and subtropical regions (Maass *et al*., 2010; Shubha *et al*., 2024). As an annual crop or short-lived perennial, *Lablab purpureus* is particularly well-suited to environments characterized by summer rainfall, where its drought-resistant properties allow it to thrive under challenging climatic conditions. Despite its significant adaptability and resilience, the widespread adoption of *Lablab purpureus* among farmers remains limited, largely due to a lack of awareness regarding its multifaceted benefits and uses (Guretzki & Papenbrock, 2014).

The versatility of *Lablab purpureus* extends beyond its role as a staple food source for humans; it is also valued for its capacity to provide high-quality fodder for livestock and improve soil fertility through nitrogen fixation (Ewansiha *et al*., 2007) . Its leaves, immature seeds, and pods are edible and can be prepared as nutritious vegetables, while mature dry beans serve as a significant protein source when cooked properly (Adebisi & Bosch, 2004; Cook *et al*., 2005). Moreover, the plant exhibits a remarkable ability to remain green during the dry season, thereby contributing to soil protection against erosion and enhancing the sustainability of farming systems (Murphy & Colucci, 1999).

However, one of the critical factors limiting the utilization of *Lablab purpureus* is the presence of anti-nutritional compounds, particularly cyanogenic glycosides.

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These compounds, if not adequately processed, can release hydrogen cyanide (HCN), which poses significant toxicity risks to both humans and animals (Osman, 2007). The potential for cyanide poisoning has been documented in other legumes, such as *Phaseolus lunatus* (Lima beans), where research conducted by Olawuyi *et al*. (2023) highlighted the morphological characterization and cyanide content determination in various accessions. This study underscored the importance of selecting accessions with reduced cyanide levels, which is vital for ensuring safety in consumption and addressing public health concerns.

Given these limitations, there is an urgent need to explore and characterize the genetic diversity of *Lablab purpureus* germplasm to identify accessions that exhibit lower cyanide content while maintaining favourable agronomic traits (Kongjaimun *et al*., 2022). By focusing on the selection of such varieties, this research seeks to enhance the appeal of *Lablab purpureus* as a safe and nutritious protein source. Furthermore, promoting the cultivation of this legume can play a pivotal role in improving food security, sustainability, and resilience within tropical agricultural systems (Letting *et al*., 2022).

The current study aims to bridge these gaps in knowledge by investigating both the morphological characteristics and cyanide content of selected *Lablab purpureus* accessions. By characterizing these accessions, we can identify varieties that possess desirable attributes, such as lower cyanide levels and improved growth characteristics. Additionally, this research will analyze the relationships among different accessions based on growth and yield traits, contributing to a more comprehensive understanding of genetic diversity within the species. Such insights are crucial for informing breeding programs aimed at enhancing both yield and safety, ultimately supporting the broader goal of sustainable agricultural practices in tropical regions (Abdel-Wahab *et al*., 2002; Cook *et al*., 2005).

Through systematic investigation and characterization of *Lablab purpureus*, this study aims to provide valuable insights into the potential of this underutilized legume as a high-yielding and safe crop. The implications of this research extend beyond mere academic interest, offering practical benefits for sustainable agriculture, improved livestock feeding strategies, and enhanced nutritional options for human consumption.

MATERIALS AND METHODS

Experimental Design, Location and Planting Materials

Field experiment was conducted at the nursery farm of the Department of Botany, University of Ibadan, Ibadan, Nigeria, from June to October 2021. The experimental layout was arranged in a complete randomized design with three replicates. The determination of cyanide content in the Lablab accessions was performed at Kappa Biotechnology Laboratory, Ibadan. The planting materials consisted of 20 accessions of *Lablab purpureus*, sourced from the Germplasm Collection of the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria. The accessions include the six listed in Plate 1, along with TLn 21, TLn 13, TLn 49, TLn 7, TLn 11, TLn 51, TLn 64, TLn 6, TLn 4, TLn 5, TLn 55, TLn 2, and TLn 44.

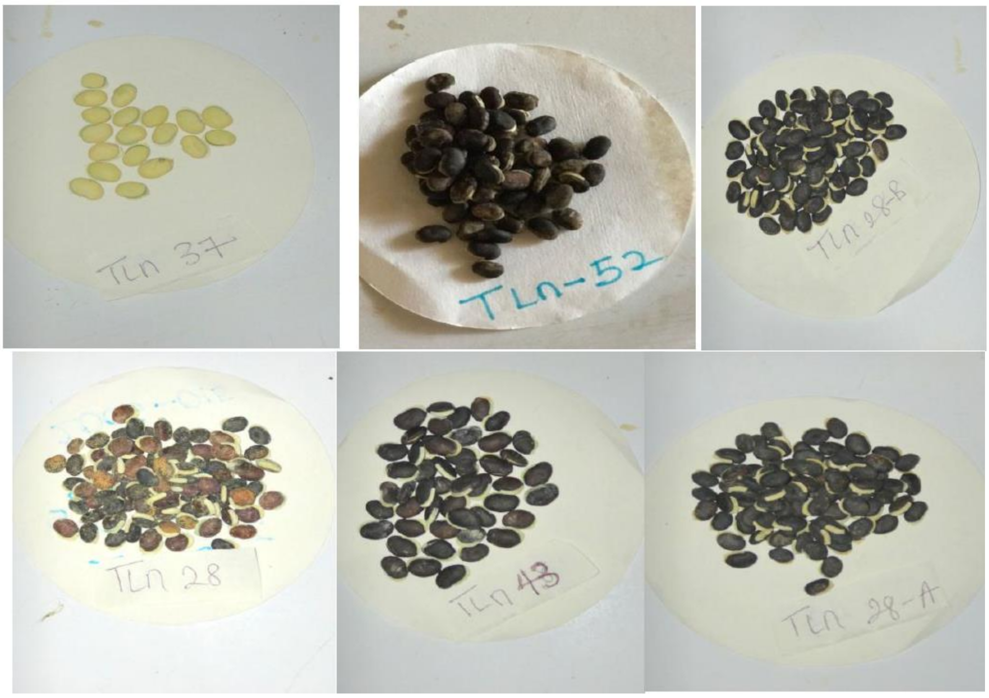

Plate 1: Six out of the 20 accessions of *L. purpureus* used in this study

Seed Preparation and Planting

Seeds were scarified using a scalpel to enhance germination and eliminate dormancy according to the procedure reported by Tang *et al*. (2019). Planting was performed by bagging loamy soil into perforated polythene bags measuring 40 cm by 45 cm, with each bag filled with 20 kg of soil and spaced 20 cm apart to prevent water logging. Two seeds were sown per bag at a depth of approximately 1 cm, and each accession was replicated thrice. The bags received an initial watering of 500 ml, and by the third day, germination was observed. Regular agronomic practices were conducted, including watering (initially daily, later every two days with 750 ml per bag), weeding, and twining of vines around stakes as they grew.

Morphological Evaluation

Morphological characters were evaluated for a period of 19 weeks based on the descriptors for *Dolichos* beans (*Lablab purpureus*) by Byregowda *et al*. (2015). After the first week, plant height was measured weekly from ground level to the tip of the leaf and recorded in centimetres. Leaflet length was measured at the terminal leaflet of the third trifoliate leaf, particularly from the pulvinus to the leaf tip while leaf width was measured midway along the leaf length. Petiole length was determined from the leaf attachment point to the stem, while fresh pod length was assessed as the average length of 20 randomly selected mature pods. Seed dimensions, including length, width, and thickness, were measured from randomly chosen seeds, and the average weight of 100 seeds was recorded. In addition to quantitative measurements, qualitative characteristics were also evaluated. Flower colour was classified as either white or purple, and the shape of leaves was noted as round for all accessions. Pod curvature was assessed on fully expanded immature pods, which could be categorized as straight, slightly curved, or curved. The colour of the mature pods was observed as green when fresh and brown when dried. The number of pods per plant and the number of locules per pod were averaged from 10 randomly selected pods. The shape of seeds was classified as round, oval, or flat.

Laboratory Analysis

Cyanide content determination was performed on six accessions of *Lablab purpureus* seeds, which were ground to a powdered form. Hydrogen cyanide (HCN) content was assessed using the alkaline picrate colorimetric method, as described by (Balagopalan & Rajalakshmy, 1998). A 2 g sample of each powdered seed was dispersed in 50 mL of distilled water within a 25 mL conical flask. An alkaline picrate paper was suspended above the sample and incubated overnight. The picrate papers were eluted by dipping them into 60 ml of distilled water. A standard cyanide solution was prepared, and the absorbance of the eluted solutions was measured using a colorimeter at a wavelength of 540 nm. The cyanide content was calculated using the formula:

$$\text{HCN (mg/kg)} = \frac{1000}{w} . \frac{\text{au}}{as} . C . D$$

Where W= weight of sample analysed, au=absorbance of test sample, as= absorbance of standard HCN solution, C= concentration of the standard in mg/d, D= dilution factor where applicable

Statistical Analysis

Data from morphological evaluations and cyanide content determinations were subjected to one-way analysis of variance (ANOVA) using the Statistical Package for Social Sciences (SPSS) version 23. Means were separated using Duncan's Multiple Range Test (DMRT) at a 95% probability level, and a correlation matrix was employed to illustrate the relationships among the studied characters.

Results

Qualitative characters of *Lablab purpureus*

The qualitative characters of the accessions of *Lablab purpureus* were evaluated (Table 1). These included plant type, leaf shape, flower colour, pod curvature, fresh pod colour, dry pod colour, seed shape, and seed colour.

Table 1: The qualitative characters of the accessions of *Lablab purpureus*

Accession	Category	Leaf Shape	Flower colour	Pod curvature	Fresh pod colour	Dry pod colour	Seed shape	Seed colour
Tln21	Early Cultivar	Round	White	Slightly Curved	Green	Brown	Round	Brown
Tln13	Early Cultivar	Round	White	Slightly Curved	Green	Brown	Oval	Cream
Tln49	Late Cultivar	Round	Purple	Slightly Curved	Green	Brown	Round	Mixture
Tln7	Late Cultivar	Round		Slightly Curved		Brown	Oval	Black
Tln11	Late Cultivar	Round	White	Slightly Curved	Green	Brown	Round	Brown
Tln51	Early Cultivar	Round	Purple	Slightly Curved	Green	Brown	Round	Mixture
Tln28	Early Cultivar	Round	Purple	Slightly Curved	Green	Brown	Round	Mixture
Tln64	Early Cultivar	Round	Purple	Slightly Curved	Green	Brown	Oval	Black
Tln6	Early Cultivar	Round	White	Slightly Curved	Green	Brown	Oval	Cream
Tln70	Late Cultivar	Round		Slightly Curved		Brown	Oval	Black
Tln43	Late Cultivar	Round		Slightly Curved		Brown	Oval	Black
28-A	Early Cultivar	Round	Purple	Slightly Curved	Green	Brown	Round	Black
Tln37	Early Cultivar	Round	White	Slightly Curved	Green	Brown	Oval	Cream
Tln4	Early Cultivar	Round	White	Slightly Curved	Green	Brown	Oval	Brown
Tln5	Late Cultivar	Round	White	Slightly Curved	Green	Brown	Oval	Cream
Tln55	Late Cultivar	Round		Slightly Curved		Brown	Oval	Brown
Tln52	Early Cultivar	Round	Purple	Slightly Curved	Green	Brown	Round	Black
28-B	Early Cultivar	Round	Purple	Slightly Curved	Green	Brown	Round	Black
Tln2	Early Cultivar	Round	White	Slightly Curved	Cream	Brown	Oval	Black
Tln44	Late Cultivar	Round				Brown	Oval	Brown

Means square variance of growth characters of *Lablab purpureus*

The mean square effects of accessions and replicates on growth characters of *Lablab purpureus* in Table 2 indicate that both accession and replicate produced non-significant effect on plant height, leaf length, leaf width, petiole length and number of leaves**.** The corrected model explained some variation, with mean squares of 136.33 (PH), 4.95 (LL), 7.93 (LW), 14.06 (PL), and 22.58 (NOL), but a large proportion of the variation remained unexplained and was attributed to random error. For instance, the error variances were 657.33 (PH), 10.8 (LL), 13.16 (LW), 30.72 (PL), and 160.06 (NOL), suggesting considerable variability not accounted for by the model.

Means square variance of yield characters of *Lablab purpureus*

The result in Table 3 shows that the accessions of *Lablab purpureus* had a highly significant ($p < 0.01$) effect on all yield characters, including the number of pods (NOP), number of seeds per pod (NOSP), number of locules per pod (NOLP), number of seeds per replicate (NOSPR), pod length (PL), pod width (PW), weight of fresh pod (WFP), weight of dry pod (WDP), seed length (SL), seed width (SW), seed thickness (ST), and 100-seed weight (100SW). This suggests that the genetic differences among accessions strongly influenced these traits.

The corrected model explained significant variation in the dataset, with notable mean square values: 504.19 for NOP, 11.69 for NOSP, 11.87 for NOLP, and 7791.62 for NOSPR. The intercepts were also substantial, with 8664.02 for NOP and 153104.6 for NOSPR, indicating that baseline values played dominant role in the observed variation, further emphasizing the importance of genetic factors in determining the traits.

Table 2: Mean square variance of growth characters in *Lablab purpureus*

Sources of Variation	DF	PH	LL	LW	PL	NOL
Corrected Model	59	136.33	4.95	7.93	14.06	22.58
Intercept	1	92411.67	45177.94	43704.96	50400.67	33948.04
Accession No	19	317.42 ns	9.64 ns	18.04 ns	33.01 ns	49.61 ns
Replicate	2	17.04 ns	4.06 ns	5.00 ns	20.55 ns	0.42 ns
Error	360	657.33	10.8	13.16	30.72	160.06
Corrected Total	419					

PH- Plant Height, LL- Leaf length, LW- Leaf Width, PL- Petiole Length, NOL-Number of leaves *Significant at $p < 0.05$, ** = Highly significant at $p < 0.01$, ns = Non –significant, Df = Degree of freedom

Table 3: Mean square variance of yield characters in *Lablab purpureus.*

Sources of Variation	Df	NOP	NOSP	NOLP	NOSPR	PL	PW	WFP	WDP	SL	SW	ST	100SW
Corrected model	19	504.19	11.69	11.87	7791.62	30.37	2.84	442.33	56.38	89.11	44.7	18.87	735
Intercept	1	8664.02	268.82	273.07	153104.6	684.79	64.27	6805.35	999.6	2045.89	1021.76	419.07	16335
Accession	19	504.19**	11.69**	11.87**	7791.62**	30.37**	2.84**	442.33**	56.38**	89.11**	44.70**	18.87**	735.00**
Error	40												
Corrected Total	59												

NOP-Number of pods per replicate, NOSP-Number of seeds per pod, NOLP-Number of locules per pod, NOSRP-Number of seeds per replicate, PL- Pod Length, PW-Pod Width, WFP- Weight of Fresh pod, WDP- Weight of dry pod, SL- Seed Length, SW- Seed Width, ST- Seeds Thickness. Significant at $p < 0.05$, ** = Highly significant at $p < 0.01$, ns = Non –significant, Df = Degree of freedom.

Growth Performance of *Lablab purpureus* accessions

The analysis of plant traits across genotypes revealed significant variation in growth performance (Table 4). Plant height ranged from 10.09 cm in TLn 43, indicating a compact growth habit, to 23.82 cm in TLn 2, demonstrating exceptional growth potential. Leaf length showed considerable variation, with the longest leaves recorded in TLn 70 (11.68 cm) and the shortest in TLn 13 (9.30 cm), suggesting differences in photosynthetic surface area among genotypes. Leaf width followed a similar trend, with TLn 37 exhibiting the widest leaves (13.20 cm) and TLn 2 the narrowest (7.95 cm). Petiole length ranged from 6.48 cm in TLn 43 to 12.71 cm in TLn 2, with longer petioles potentially enhancing light capture efficiency. Statistical analysis indicated significant differences ($p < 0.05$) for plant height across accessions, with TLn 2 significantly taller and TLn 43 significantly shorter. Leaf length in TLn 70 and TLn 5 differed significantly from other accessions, while genotypes such as TLn 64, TLn 52, TLn 28-A, TLn 55, TLn 37, TLn 49, and TLn 4 showed no significant differences in leaf width. Similarly, TLn 21, TLn 5, TLn 11, TLn 6, TLn 64, TLn 28-B, TLn 51, TLn 28, and TLn 43 were comparable in leaf traits, with TLn 70 and TLn 7 showing highly significant ($p < 0.05$) leaf measurements.

Table 4: Growth Performance of *Lablab* accessions

Accession	PH (cm)	LL (cm)	LW (cm)	PL(cm)	NOL (cm)
TLn 43	10.09^{a}	10.49^{ab}	10.31^{abc}	11.79^{abc}	6.48^{a}
TLn 64	10.95^{a}	11.38^{ab}	11.37^{ab}	12.21^{ab}	8.00^{a}
TLn 28	11.71^{a}	9.50^{ab}	9.76^{abc}	12.39^{abc}	8.24^{a}
TLn 51	11.74^{a}	10.51^{ab}	10.20^{abc}	11.60^{abc}	8.00^{a}
TLn 28-B	12.25^{a}	10.15^{ab}	10.21^{abc}	11.59^{abc}	8.48^{a}
TLn 52	12.30^{a}	10.53^{ab}	10.80^{ab}	10.92^{abc}	7.76^{a}
TLn 28-A	12.61^{a}	10.16^{ab}	10.68^{ab}	11.88^{abc}	8.24^{a}
TLn 70	12.64^{a}	11.68^{a}	11.73^{a}	11.62^{abc}	10.67^{a}
TLn 44	12.73^{a}	10.04^{ab}	10.28^{abc}	10.21^{abc}	9.33^{a}
TLn 7	12.85^{a}	11.49^{ab}	11.50^{a}	11.07^{abc}	8.00^{a}
TLn 55	12.85^{a}	10.05^{ab}	10.58^{ab}	10.96^{abc}	7.76^{a}
TLn 6	13.69^{a}	10.24^{ab}	9.34^{abc}	10.73^{abc}	8.57^{a}
TLn 37	14.51^{a}	10.31^{ab}	10.63^{ab}	13.20^{a}	9.62^{a}
TLn 49	14.72^{a}	11.22^{ab}	10.67^{ab}	10.63^{abc}	8.00^{a}
TLn 13	17.66^{a}	9.30^{ab}	8.00^{c}	11.70^{abc}	8.67^{a}
TLn 4	19.08^{a}	10.38^{ab}	10.66^{ab}	10.22^{abc}	10.71^{a}
TLn 11	19.08^{a}	10.21^{ab}	9.14^{abc}	8.69^{bc}	9.33^{a}
TLn 5	20.09^{a}	9.20^{b}	9.47^{abc}	10.04^{abc}	9.14^{a}
TLn 21	21.18^{a}	10.71^{ab}	9.93^{abc}	9.71^{abc}	12.10^{a}
TLn 2	23.82^{a}	9.87^{ab}	8.78^{c}	7.95^{c}	12.71^{a}

Rep- Replicate, PH- Plant Height, LL- Leaf length, LW- Leaf Width, PL- Petiole Length, NOL-Number of leaves. Mean with the same letter in the same column are not significantly different at $p \leq 0.05$ using Duncan's Multiple range Test (DMRT).

Yield performance of *Lablab purpureus*

The analysis of yield traits in various accessions of *Lablab purpureus* revealed significant variation in pod and seed characteristics (Table 5). The traits assessed included the number of pods per replicate (NOP), number of seeds per pod (NOSP), number of locules per pod (NOLP), number of seeds per replicate (NOSR), pod length (PL), pod width (PW), weight of fresh pod (WOFP), weight of dry pod (WODP), seed length (SL), seed width (SW), and seed thickness (ST).

The accessions exhibited a broad range of performance across the traits. Accessions TLn 5, TLn 6, TLn 7, TLn 43, TLn 49, TLn 55, TLn 64, and TLn 70 had no measurable yield. Conversely, accessions TLn 28, TLn 28-B, and TLn 36 demonstrated the highest performance, particularly in traits like the number of seeds per replicate and pod length. TLn 28 showed the highest number of pods per replicate (32.00), seeds per pod (4.00), locules per pod (4.00), and seeds per replicate (128.00), indicating superior yield potential. TLn 36 also demonstrated a high number of seeds per replicate (134.00). Accessions TLn 4, TLn 28-A, and TLn 28 displayed significant differences in pod length, while TLn 52 and TLn 37 also exhibited notable variation. In pod width, TLn 52, TLn 51, TLn 28-A, TLn 28, and TLn 37 showed no significant differences, whereas TLn 21, TLn 13, and TLn 28-B were significantly different from other accessions. TLn 4 and TLn 2 exhibited significant extremes in pod width.

In terms of the weight of fresh pods, TLn 4, TLn 2, TLn 13, TLn 51, TLn 21, and TLn 28-A showed no significant differences, while TLn 28 and TLn 37 had significantly higher weights. For the weight of dry pods, TLn 4, TLn 2, TLn 13, TLn 51, TLn 21, TLn 28-B, and TLn 37 did not differ significantly, but TLn 52 and TLn 11 were significantly different, with TLn 11 showing the lowest values. In seed length, TLn 4, TLn 2, and TLn 37 were significantly higher, while TLn 51 was significantly lower. No significant differences were observed between TLn 13, TLn 11, TLn 21, TLn 52, TLn 28-A, and 28-B. For seed width, TLn 4, TLn 11, TLn 21, and TLn 28 were significantly higher, while TLn 28-A had the lowest seed width. The accessions TLn 52 and TLn 28-B showed no significant differences from each other while TLn 2, TLn 13, TLn 51, and TLn 37 exhibited significant differences in seed width. Seed thickness showed significant differences between TLn 2 and TLn 51, with TLn 11 and TLn 37 showing no significant differences. The accessions TLn 4, TLn 52, TLn 21, TLn 28-A, and TLn 28-B demonstrated significant variation in seed thickness.

Table 5: Yield performance of *Lablab* accessions.

NOP	NOSP	NOLP	NOSPR	PL	PW	WFP	WDP	SL	SW	ST	100SW
TLn 4	8.67^{cd}	3.33^{b}	3.33^{b}	28.67^{de}	6.47^{b}	2.10^{a}	15.00^{bc}	5.00^{bc}	11.84^{a}	8.11^{a}	5.51^{b}
TLn 2	9.33^{c}	4.00^{a}	4.00^{a}	37.33^{de}	6.00^{bc}	1.47^{e}	8.33^{cd}	5.00^{bc}	11.54^{a}	8.00^{ab}	6.09^{a}
TLn 13	15.67^{c}	4.00^{a}	4.00^{a}	62.67^{cd}	6.00^{bc}	1.97^{bc}	16.67^{bc}	4.67^{bc}	10.96^{b}	7.40^{c}	4.84^{c}
TLn 52	16.33^{c}	3.33^{b}	3.33^{b}	62.00^{cd}	5.00^{d}	2.00^{b}	8.67^{cd}	8.67^{b}	9.92^{cd}	6.68^{de}	4.33^{d}
TLn 11	16.67^{c}	4.00^{a}	4.00^{a}	66.67^{cd}	8.03^{a}	1.47^{e}	22.67^{b}	4.33^{c}	10.74^{b}	8.12^{a}	4.46^{cd}
TLn 51	24.67^{c}	4.00^{a}	4.00^{a}	98.67^{abc}	6.33^{b}	2.00^{b}	15.33^{bc}	7.67^{bc}	9.59^{d}	6.84^{d}	3.87^{e}
TLn 21	25.33^{c}	4.00^{a}	4.00^{a}	101.33^{ab}	6.00^{bc}	1.90^{c}	16.00^{bc}	6.00^{bc}	10.74^{b}	8.13^{a}	5.88^{ab}
28-A	25.67^{b}	4.00^{a}	4.00^{a}	102.67^{ab}	6.17^{b}	2.00^{b}	14.33^{bc}	12.67^{a}	9.78^{cd}	6.56^{e}	4.29^{d}
28-B	30.00^{ab}	4.00^{a}	4.00^{a}	120.00^{a}	6.00^{bc}	1.80^{d}	22.33^{b}	8.00^{bc}	9.93^{cd}	6.77^{de}	4.23^{de}
TLn 28	32.00^{ab}	4.00^{a}	4.00^{a}	128.00^{a}	6.10^{b}	2.00^{b}	37.00^{a}	12.33^{a}	10.15^{c}	8.12^{a}	4.88^{c}
TLn	36.00^{a}	3.67^{ab}	4.00^{a}	134.000^{a}	5.47^{cd}	2.00^{b}	36.67^{a}	7.30^{bc}	11.59^{a}	7.81^{b}	4.47^{cd}

NOP-Number of pods per replicate, NOSP-Number of seeds per pod, NOLP-Number of locules per pod, NOSRP-Number of seeds per replicate, PL- Pod Length, PW-Pod Width, WFP- Weight of Fresh pod, WDP- Weight of dry pod, SL- Seed Length, SW- Seed Width, ST- Seeds Thickness. Mean with the same letter in the same column are not significantly different at p ≤ 0.05 using Duncan's Multiple range Test (DMRT).

Correlation of growth characters of *Lablab purpureus*

The correlation analysis of morphological traits in *Lablab purpureus* accessions (Table 6) revealed significant relationships among plant height (PH), leaf length (LL), leaf width (LW), petiole length (PL), and the number of leaves (NOL). Weekly measurements and replicates were also evaluated to assess their influence on the traits. Accession number (Acc no) showed no significant correlation with any of the measured traits, suggesting that the traits are not directly influenced by specific accession identities. Weekly growth was strongly associated with key morphological traits, including PH (r = 0.92**), LL (r = 0.88**), LW (r = 0.91**), and PL (r = -0.28**). These findings indicate substantial changes in plant growth parameters over time, although a slight decrease in the number of leaves (NOL) was observed as time progressed.

Replicate effects were negligible, with no significant correlations detected between replicates and the traits, reflecting consistency in the experimental setup. Plant height (PH) exhibited significant negative correlations with LL (r = -0.36**), LW (r = -0.39**), and PL (r = -0.36**) but a positive correlation with NOL (r = 0.33**). These results suggest that taller plants tend to have smaller leaves and shorter petioles but a higher number of leaves. Leaf length (LL) was strongly and positively correlated with LW (r = 0.92**) and PL (r = 0.88**), but negatively correlated with NOL (r = -0.35**). This indicates that plants with longer leaves tend to have wider leaves and longer petioles, although they may produce fewer total leaves.

Similarly, LW was positively correlated with PL (r = 0.84**) and negatively correlated with NOL (r = -0.23**), reinforcing the relationship between leaf dimensions and petiole length. Petiole length (PL) showed a weak but significant negative correlation with NOL (r = -0.19**), suggesting a trade-off between petiole length and leaf count. The number of leaves (NOL) showed no significant positive correlation with other traits but negatively correlated with LL, LW, and PL, indicating that plants with smaller and shorter leaves tend to have a higher leaf count.

Correlation analysis of yield characters of *Lablab purpureus*

The correlation analysis of yield characters in *Lablab purpureus* (Table 7) revealed several relationships among the yield traits measured. Significant positive correlations were observed across most of the traits, suggesting their interconnected influence on overall yield performance. For instance, NOP demonstrated highly significant correlations with NOSP (r = 0.84**), NOLP (r = 0.85**), NOSRP (r = 0.99**), PL (r = 0.79**), and PW (r = 0.83**), reflecting its central role in yield determination. Similarly, NOP was strongly associated with WFP (r = 0.91**), WDP (r = 0.89**), SL (r = 0.80**), SW (r = 0.80**), ST (r = 0.76**), and 100SW (r = 0.72**).

Traits such as NOSP and NOLP exhibited a nearly perfect correlation (r = 0.99**) and were also highly correlated with PL (r = 0.98**), PW (r = 0.97**), SL (r = 0.98**), SW (r = 0.98**), ST (r = 0.96**), and 100SW (r = 0.96**). These findings highlight their combined contribution to seed and pod development. PL and PW were strongly correlated with each other (r = 0.96**) and with key pod and seed traits such as SL (r = 0.98**), SW (r = 0.98**), and 100SW (r = 0.97**). WFP and WDP showed moderate to strong correlations with SL (r = 0.77**), SW (r = 0.79**), and ST (r = 0.72**), emphasizing their importance in pod biomass and seed production. Seed traits, including SL, SW, and ST, demonstrated nearly perfect intercorrelations (r = 0.99**) and were strongly associated with 100SW, indicating the tight linkage between seed size and weight.

These results indicate that NOP, NOSP, NOLP, PL, and PW are pivotal traits influencing both pod and seed yield, while SL, SW, ST, and 100SW serve as critical indicators of seed quality. The high degree of correlation among these traits underscores the potential for indirect selection in breeding programs aimed at improving yield and seed quality in *Lablab purpureus*

Table 6: Correlation coefficient of growth characters of *Lablab*.

Acc no	Week	Rep	PH	LL	LW	PL	NOL
Acc no	0.00	0.00	-0.06	0.01	0.07	0.08	-0.03
Week		0.00	-0.46**	0.92**	0.88**	0.91**	-0.28**
Rep			0.00	0.00	0.02	0.05	-0.00
PH				-0.36**	-0.39**	-0.36**	0.33**
LL					0.92**	0.88**	-0.35**
LW						0.84**	-0.23**
PL							-0.19**
NOL							

Acc no- Accession number, Rep- Replicate, PH- Plant Height, LL-Leaf length, LW- Leaf Width, PL- Petiole length, NOL- Number of leaves. *= Significant at $p = 0.50$, ** = Highly significant at $p < 0.50$.

Table 7: Correlation coefficient of yield characters of *Lablab*.

NOP	NOSP	NOLP	NOSRP	PL	PW	WFP	WDP	SL	SW	ST	100SW
NOP	0.84**	0.85**	0.99**	0.79**	0.83 **	0.91**	0.89**	0.80**	0.80**	0.76**	0.72**
NOSP		0.99**	0.84**	0.98 **	0.97 **	0.78**	0.82**	0.98**	0.98**	0.96**	0.96**
NOLP			0.85**	0.98 **	0.97 **	0.79**	0.82**	0.98**	0.98**	0.96**	0.96**
NOSRP				0.78**	0.82 **	0.91**	0.89**	0.78**	0.79**	074**	0.70**
PL					0.96**	0.77**	0.77**	0.98**	0.98**	0.95**	0.97**
PW						0.77**	0.82**	0.98**	0.97**	0.95**	0.95**
WFP							0.79**	0.77**	0.79**	0.72**	0.69**
WDP								0.77**	0.77**	0.74**	0.74**
SL									0.99**	0.99**	0.99**
SW										0.98**	0.99**
ST											0.99**
100SW											

NOP-Number of pods per replicate, NOSP-Number of seeds per pod, NOLP-Number of locules per pod, NOSRP-Number of seeds per replicate, PL- Plant Length, PW-Pod Width, WFP- Weight of Fresh pod, WDP- Weight of dry pod, SL- Seed Length, SW- Seed Width, ST- Seeds Thickness, 100SW- 100 Seed weight. *= Significant at $p = 0.50$, ** =Highly significant at $p < 0.50$.

Principal Component Analysis (PCA) of Growth Characters

PCA was performed to examine the relationships among variables, and the rotated component plot (Figure 2a) illustrated their distribution in a three-dimensional space. The three components explained a significant portion of the variance and were rotated for better interpretability. distinct groupings were observed: ac number and replicate aligned with component 2, while leaf length, leaf width, and flower week were strongly associated with component 3, suggesting shared functional relationships. Plant height and no of leaves were primarily aligned with component 1, reflecting their unique variance contributions. The clustering of leaf length, leaf width, and flower week suggests correlated biological traits, while the isolation of ac number and replicate along component 2 indicates distinct variation patterns. These findings offer insights into trait relationships and variability, guiding further analysis.

Principal Component Analysis (PCA) of Yield Characters

Principal Component Analysis (PCA) revealed distinct associations among the measured traits (Fig. 2b). number of seeds per rep, number of pods, weight of dry pod, and weight of fresh pod clustered together with high positive loadings on component 1, indicating strong correlations related to pod productivity. Similarly, the number of locules per pod, number of seeds per pod, pod width, and pod length were positively associated with component 1, suggesting relationships with seed production. Acc no (accession number) aligned with component 2, highlighting its unique contribution, while replicating showed minimal influence on the primary traits. Seed thickness was closely linked with pod-related characteristics, suggesting its relevance in pod morphology and seed development. These findings provide insights into trait variability and potential relationships for further exploration.

(a)

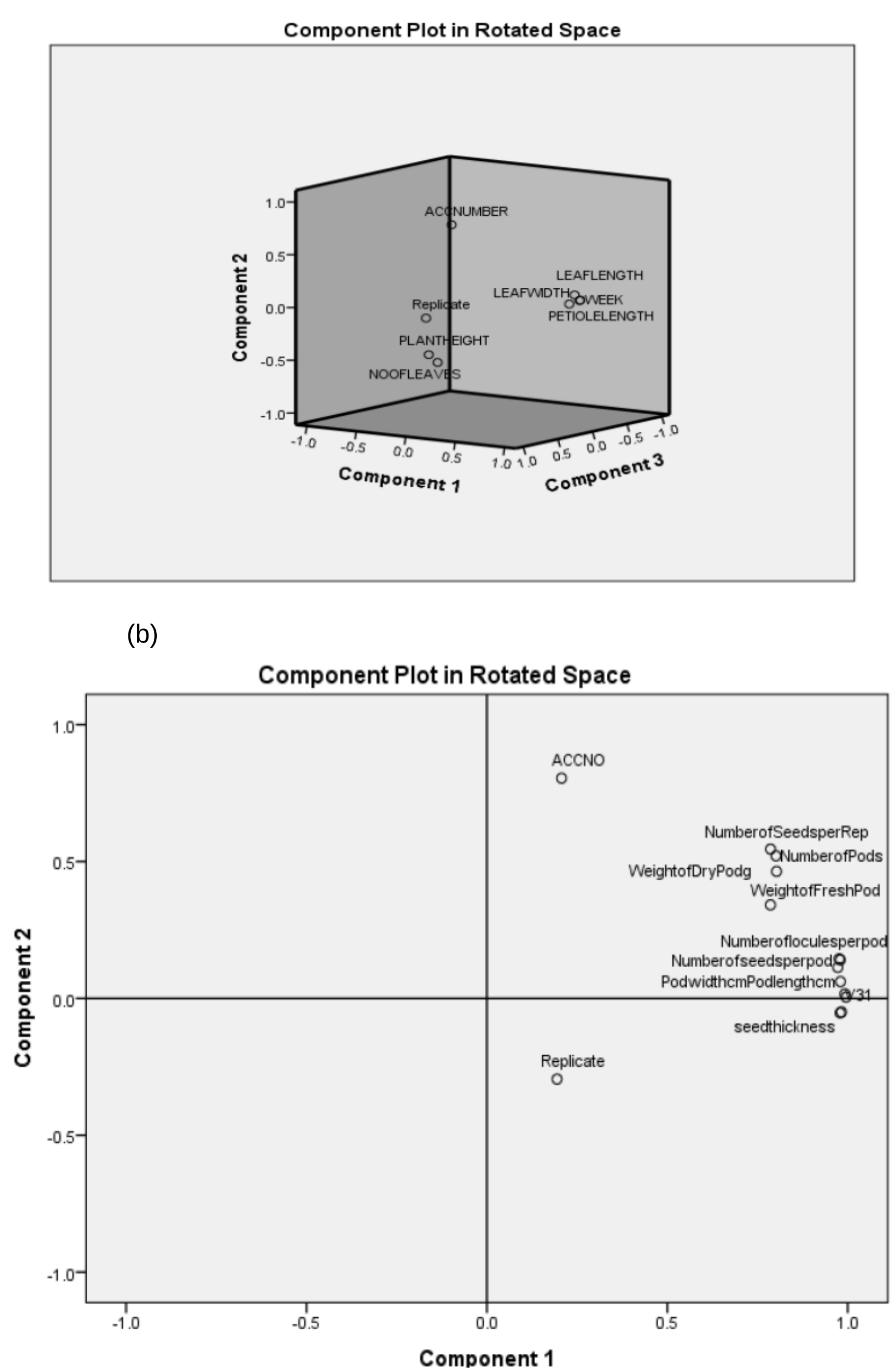

Fig 2. Component plots showing (a) growth characters, and (b) yield characters of *Lablab purpureus*.

Qualitative analysis of cyanide content of *Lablab purpureus*

The analysis of six accessions of *Lablab purpureus* showed variations in cyanide content (Table 8). The analysis revealed variations in cyanide content among the accessions, measured in mg per 100g across three replicates. Cyanide content ranged from undetectable levels (ND, equivalent to 0.00 mg/100g) to a maximum of 0.04 mg/100g. Among the tested accessions, 28-A exhibited consistent cyanide content across replicates, with values ranging from 0.03 to 0.04 mg/100g. Similarly, 28-B showed slightly lower cyanide content, varying between 0.01 and 0.02 mg/100g. The accession TLn 28 presented the lowest detected cyanide levels, consistently at 0.01 mg/100g in two replicates and a slight increase to 0.02 mg/100g in one replicate. In contrast, TLn 37 did not exhibit detectable levels of cyanide in any of the replicates, indicating a value of 0.00 mg/100g. This makes TLn 37 unique among the tested accessions. TLn 43 showed slight variability, with cyanide content ranging between 0.01 and 0.03 mg/100g, while TLn 52 exhibited relatively consistent cyanide levels, fluctuating between 0.02 and 0.03 mg/100g.

Table 8: Cyanide test on six accessions of *Lablab purpureus.*

Accession number	Sample	Cyanide content (mg/100g)
28-A	1	0.03
	2	0.04
	3	0.03
28-B	1	0.02
	2	0.01
	3	0.02
TLn 28	1	0.01
	2	0.01
	3	0.02
TLn37	1	ND
	2	ND
	3	ND
TLn43	1	0.03
	2	0.01 37
	3	0.03
TLn52	1	0.02
	2	0.03
	3	0.03

ND=Not detected which can be equivalent to 0.00

DISCUSSION

The results from this study indicate significant variation in the morphological traits among the 20 accessions of *Lablab purpureus*. Accessions TLn70, TLn7, and TLn37 exhibited the best growth characteristics, while TLn28, TLn28-A, TLn28-B, and TLn37 demonstrated superior yield traits. TLn52 showed a moderate yield, whereas TLn43 recorded the lowest yield, aligning with findings by Ali *et al*. (2005). TLn70 excelled in growth traits, including plant height, leaf length, leaf width, and number of leaves, consistent with observations made by Mohan & Aghora (2009). The highest yield characteristics, particularly in terms of the number of pods, seeds, and seed thickness, were noted in TLn28, corroborating the results reported Ali *et al*. (2005). The mean square for yield traits indicated that the accession significantly influenced yield parameters, including the number of pods, seeds per pod, locules per pod, seeds per replicate, pod dimensions (length and width), and weights of fresh and dry pods, as well as seed dimensions (length, width, and thickness). The findings suggests that the traits examined are largely influenced by factors outside the scope of this study, such as uncontrolled environmental conditions or unmeasured genetic interactions. Future studies should aim to include more precise environmental controls or additional genetic markers to better capture the sources of variation.

Correlation analysis revealed positive relationships among growth characters, including plant height, leaf length, leaf width, and petiole length, consistent with the findings of Olawuyi *et al*., (2023). Similarly, yield traits such as the number of seeds, locules, pod dimensions, weights of dry and fresh pods, seed length, width, thickness, and seed weight were positively correlated, aligning with observations from Kambale *et al*. (2016) and supporting the results of Ali *et al*. (2005). The observed variation among accessions may be attributed to genetic diversity and varying adaptability to the growing environment (Olawuyi & Azeez, 2019; Azeez *et al*., 2020). This variation suggests that these traits are genetically controlled and thus amenable to genetic improvement, offering opportunities to enhance desirable morphological characteristics of *Lablab purpureus*.

In the second part of this study, we assessed the cyanide content in six selected accessions, including TLn28 (mixed coloured seed), TLn43 (black seed), TLn37 (cream coloured seed), TLn52 (black seed), and 28-A and 28-B (both black seeds). The results indicated that TLn37 contained no detectable cyanide, which could have implications for their safety or suitability for consumption The other accessions had very low cyanide levels, well below the acceptable limit of 36 mg/100 g as established by Kala *et al*. (2010). The absence of cyanide in TLn37 may be linked to its seed colour, a finding that supports Duke *et al*. (1983), who noted that darker seeds tend to have higher cyanide content.

CONCLUSION AND RECOMMENDATION

Lablab purpureus (L.) possesses a variety of traits that position it as a viable alternative to more widely cultivated legumes. Its genetic diversity makes it a valuable resource for identifying germplasm suitable for specific regions and farmer requirements. The morphological characterization conducted in this study has demonstrated variability among *Lablab purpureus* accessions concerning plant height, leaf dimensions, petiole length, and leaf number. This research provides preliminary data on the diversity of *Lablab purpureus*, facilitating the selection of elite accessions for future crop improvement and commercial cultivation. The cyanide analysis revealed that TLn37 contained no cyanide, while TLn28, TLn43, TLn52, 28-A, and 28-B exhibited levels insignificantly lower than the accepted value of 36 mg/100 g, indicating that these accessions might be safe for human and animal consumption. Based on these findings, we recommend further research efforts especially on comparative phytochemical composition of the accession TLn37 and others, as well as promoting it for wider cultivation due to its great potential. Additionally, late-maturing cultivars like TLn70 and TLn7, which demonstrated excellent growth characteristics, should be encouraged for pasturing. Accessions TLn28, 28-A, 28-B, TLn43, and TLn52 could benefit from genetic modification to eliminate cyanide content. Furthermore, TLn43, despite its lower yield, should undergo further enhancement to improve its yield potential.

REFERENCES

Abdel-Wahab, A., Shabeb, M., and Younis, M. 2002. Studies on the effect of salinity, drought stress and soil type on nodule activities of Lablab purpureus (L.) sweet (Kashrangeeg). J. Arid Environ., 51(4):587–602.

Adebisi, A., and Bosch, C. 2004. Lablab purpureus (L.) sweet. Plant Resour. Trop. Afr. (PROTA), 2:343–348.

Ali, F., Sikdar, B., Roy, A., and Joarder, O. 2005. Correlation and genetic variation of twenty different genotypes of lablab bean, Lablab purpureus (L.) Sweet. Bangladesh J. Bot., 34(2):125–128.

Azeez, A., Olawuyi, O., and Igata, D. 2020. Genetic diversity of Garcinia kola Heckel from selected states in Nigeria. J. Res. For. Wildl. Environ., 12(3):92–105.

Balagopalan, C., and Rajalakshmy, L. 1998. Cyanogen accumulation in the environment during the processing of cassava (Manihot esculenta Crantz) for starch and sago. Water Air Soil Pollut., 102:407–413.

Byregowda, M., Girish, G., Ramesh, S., Mahadevu, P., and Keerthi, C. 2015. Descriptors of dolichos bean (Lablab purpureus L.). J. Food Legumes, 28(3):203–214.

Cook, B. G., Pengelly, B. C., Brown, S., Donnelly, J., Eagles, D., Franco, M., Hanson, J., Mullen, B. F., Partridge, I., and Peters, M. 2005. Tropical forages: An interactive selection tool.

Duke, J. 2012. Handbook of legumes of world economic importance. Springer Science and Business Media.

Ewansiha, S. U., Chiezey, U. F., Tarawali, S. A., and Iwuafor, E. N. O. 2007. Potential of Lablab purpureus accessions for crop-livestock production in the West African savanna. J. Agric. Sci., 145(3):229–238. https://doi.org/10.1017/S0021859606006599

Guretzki, S., and Papenbrock, J. 2014. Characterization of Lablab purpureus regarding drought tolerance, trypsin inhibitor activity, and cyanogenic potential for selection in breeding programmes. J. Agron. Crop Sci., 200(1):24–35. https://doi.org/10.1111/jac.12043

Kala, B. K., Kalidass, C., and Mohan, V. R. 2010. Nutritional and antinutritional potential of five accessions of a South Indian tribal pulse Mucuna atropurpurea DC. Trop. Subtrop. Agroecosyst., 12(2):339–352.

Kambale, S., Devmore, J., Bhave, S., and Dhekale, S. S. J. 2016. Genetic variability for yield and yield-attributing traits in F4 generation of lablab bean (Lablab purpureus L. Sweet). Electron. J. Plant Breed., 7(3):809–813.

Kongjaimun, A., Takahashi, Y., Yoshioka, Y., Tomooka, N., Mongkol, R., and Somta, P. 2022. Molecular analysis of genetic diversity and structure of the lablab (Lablab purpureus (L.) Sweet) gene pool reveals two independent routes of domestication. Plants, 12(1):57. https://doi.org/10.3390/plants12010057

Letting, F. K., Venkataramana, P. B., and Ndakidemi, P. A. 2022. Farmers' participatory plant selection of lablab (Lablab purpureus (L.) Sweet) in Tanzania. Front. Plant Sci., 13:784032. https://doi.org/10.3389/fpls.2022.784032

Maass, B. L., Knox, M. R., Venkatesha, S. C., Angessa, T. T., Ramme, S., and Pengelly, B. C. 2010. Lablab purpureus—A crop lost for Africa? Trop. Plant Biol., 3(3):123–135. https://doi.org/10.1007/s12042-010-9046-1

Mohan, N., and Aghora, T. 2009. Evaluation of dolichos (Lablab purpureus L.) germplasm for pod yield and pod-related traits. J. Hortic. Sci., 4(1):50–53.

Murphy, A. M., and Colucci, P. E. 1999. A tropical forage solution to poor-quality ruminant diets: A review of Lablab purpureus. Livest. Res. Rural Dev., 11(2).

Olawuyi, O. J., Adeyeye, E. F., and Ajayi, I. I. 2023. Morphological characterization and cyanide content determination in Phaseolus lunatus Linn. (Lima Beans) accessions. J. Adv. Biol. Biotechnol., 26(7):11–27. https://doi.org/10.9734/jabb/2023/v26i7643

Olawuyi, O. J., and Azeez, A. A. 2019. Molecular evaluation of Garcinia kola Heckel accessions using RAPD markers. Am. J. Mol. Biol., 9(2):41–51. https://doi.org/10.4236/ajmb.2019.92004

Osman, M. A. 2007. Effect of different processing methods on nutrient composition, antinutritional factors, and in vitro protein digestibility of dolichos lablab bean (Lablab purpureus (L.) Sweet).

Shubha, K., Choudhary, A. K., Dubey, A. K., Tripathi, K., Kumar, R., Kumar, S., Mukherjee, A., Tamta, M., Kumar, U., Kumar, S., Layek, J., and Das, A. 2024. Evaluation of lablab bean [Lablab purpureus (L.) Sweet] genotypes: Unveiling superior pod yield, nutritional quality, and collar rot resistance. Front. Nutr., 10:1243923 https://doi.org/10.3389/fnut.2023.1243923

Tang, Y., Zhang, K., Zhang, Y., and Tao, J. 2019. Dormancy-breaking and germination requirements for seeds of Sorbus alnifolia (Siebold and Zucc.) K. Koch (Rosaceae), a mesic forest tree with high ornamental potential. Forests, 10(4):319. https://doi.org/10.3390/f10040319