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Phenotypic Analysis of Yield and Yield Components in Mung Bean [*Vigna radiata* (L.) Wilczek] at Gampèla, Burkina Faso

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RESEARCH ARTICLE

Abstract
Mung bean (*Vigna radiata*) is an annual legume that adapts well to dry zones. In Burkina Faso, it is considered an orphan crop. The aim of this study was to gain a better understanding of the crop by evaluating the seed and fodder yields of ten accessions. The accessions were evaluated on thirteen quantitative variables in a Fisher block design with three replications. High genetic variability between accessions was observed. Positive and negative correlations were also observed between variables. Principal component analysis (PCA) explained 65.64% of the total variability between the accessions studied. Accession M06 proved to be the most productive in terms of seed yield (i.e., 3.54 t/ha), whereas M40 reached the highest forage yield (i.e., 3.15 t/ha). Accession M42 was the most judicious, with 95% early maturity (62 days), the highest number of pods (114), good seed yield (3.06 t/ha) and forage yield (2.5 t/ha). These evaluated accessions may be taken into account in future mung bean breeding programs.

Keywords: Accessions; dry zone; yield evaluation; legume.

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INTRODUCTION

Globally, the demand for legumes to meet basic nutritional requirements is increasing (Tadele and Bartels, 2019). As in other countries, this growing demand is also experienced in Burkina Faso, creating a major constraint and urgently calling for an increase in legume productivity through the use of cultivars with high productivity performance and adapted to the climatic context. Mung bean [Vigna radiata (L.) Wilczek] is a short-cycle (60-65 days) seed legume belonging to the Fabaceae family and is widely cultivated in tropical and subtropical regions of the world (Ramanujam, 1981). It originates from the Asian continent (Sangsiri, 2009) where 90% of global production is currently carried out according to the World Vegetable Center (AVRDC, 2015). Today, it is produced in many European, South American and North American countries (Shanmugasundaram, 2009). It is also grown all over Africa (Jansen, 2006). In addition to being drought-tolerant and improving soil fertility, it is a significant and affordable source of vitamins and protein for human consumption. It can also be used as green manure or fodder for livestock (Souci et al., 2008). Introduced to Burkina Faso around the 1980s, mung bean is a legume that complements the main legumes produced, namely cowpea, voandzou, groundnut and soybean, which contribute enormously to the country's food and nutritional security (Minh, 2014). Nevertheless, it remains an underutilized legume because, despite its multiple socio-economic services, only one variety is being popularized, namely 'Beng Tigré' and its cultivation is not yet adopted by most producers (Niampa, 2016).

In Burkina Faso, there are almost no official mung bean production statistics. Indeed, according to statistics from the Food and Agriculture Organization of the United Nations (FAOSTAT, 2016), agronomic and varietal improvement research is more focused on other so-called "staple" speculations such as cowpea, rice and corn. Furthermore, there is a lack of information on the crop and its appropriate farming practices, ignorance of its potential benefits, low yields, diseases and pests, and low cultivar productivity (Mogotsi, 2006). In Burkina Faso, therefore, evaluation, improvement and innovation work on this crop must be undertaken, in order to stem the very glaring food and nutritional insufficiency encountered, and with a view to resilience in the face of climate change. A better assessment of the genetic resources introduced into Burkina Faso would provide elite varieties for legume programs in general, and mung bean in particular.

The overall objective of this study was to estimate the yield performance of mung beans in Burkina Faso. Specifically, the aim was (i) to determine which of the essential variables studied contribute most to the definition of mung bean yield, (ii) to assess forage and agronomic variability between accessions and (iii) to identify promising mung bean accessions for their use in breeding, extension and production schemes.

MATERIALS AND METHODS

Plant material consists of ten mung bean accessions introduced into Burkina Faso. These accessions came from the Australian gene bank (GenBank) and were stored in the germplasm of the CREAF/Kamboinsé plant genetics and biotechnology laboratory.

The experimental setup used was a Fisher block with three replicates. The elementary plot comprised two lines of 2 m long. Seedlings were planted 0.5 m apart between lines and 0.4 m apart between bunches, i.e. a total of six bunches per line and an elementary area (2*0.5) of 1m^2. The distance between sub-blocks was 0.8 m and between replicates 1.5 m. The area of one repetition was (12.2m*2m) 24.4 m^2 and the total area (12.2m*9m) was 109.8 m^2.

Pre-sowing operations consisted of land preparation and ploughing with a tractor, followed by levelling with a daba. Sowing was carried out manually at a rate of two to three seeds per poquet. During the trial, maintenance work was carried out to protect against weeds and pests, and to improve soil aeration. The first weeding followed by a removal of one plant per place pack was carried out on the 16th Day After Sowing (DAS). NPK fertilizer was applied manually at a rate of 100 kg/ha on the 17th day after sowing. A second weeding was carried out on the 27th day after sowing. In addition, to combat pest attacks, two phytosanitary treatments were carried out with K-Optimal: one at flower bud formation (28th JAS) and the other at pod formation (38th JAS). The treatments were carried out at a dose of 2 ml per litre of water, and were carried out for preventive purposes, K-Optimal being known for its excellent efficacy against pod-sucking insects.

The harvesting of tops by accession immediately followed that of pods. The different batches of haulms were dried in the shade for seven days.

Data were entered using Kobo toolbox software. Only one type of variable was studied. These were quantitative variables. They were taken in accordance with the recommendations set out in Biodiversity International (2007). A total of 13 parameters were studied, and the data were obtained by counting or measuring the various plots according to the plant's development cycle, as follows:

- 50% emergence date (50% Emg): the number of days until 50% of the seedlings have emerged, expressed as days after sowing (DAS);
- 50% flowering date (50% Flr): the number of days elapsed between sowing and the stage when 50% of the plants in the elementary plot have flowered expressed as Days After Sowing (DAS);
- plant height (HP): three randomly selected plants per line were measured from crown to apex using a graduated ruler at the 50% flowering stage. It is expressed in cm;
- stem diameter (SD): this is the measurement of the length of the main stem at the collar using a calliper in cm at the 50% flowering stage. Three randomly selected plants per line were measured. The diameter is expressed in mm.
- 95% maturity date (95% Mat): this is measured by counting the number of days between sowing and the stage when 95% of pods have reached dry maturity. It is expressed in Days After Sowing (DAS);

- number of pods per plant (NG/Plt): mature pods and the number of plants per elementary plot were counted, then the total number of pods was divided by the total number of plants to obtain the number of pods per plant and per plot;
- pod weight (PG): determined by averaging the accession weight of dried pods. It is expressed in g;
- Fodder weight (FW): fodder weight was determined by accession after weighing the fodder from each elementary plot using a 0.1g precision electronic balance after drying in the shade for seven days. It is expressed in g;
- 1000-seed weight (P1000Gr): this was determined by weighing 1000 seeds per accession using a 0.01g precision electronic balance. The 1000 seeds were determined using a seed counter;
- seed weight (Pgr): determined by accession after separate threshing of dried pods from each plot and weighing of sun-dried seeds for 10 days, using a 0.1g precision electronic balance (appendix 3). It is expressed in g;
- seed yield (Rdtgr): calculated from the average seed weight of elementary plots per accession.
- Yield = [(seed weight (kg) x 10000 (m^2)) /sectional area (m^2)]. It is expressed in t/ha;
- forage yield (RdtF): determined from the average haulm weight of individual plots per accession.

Yield = [(haulm weight x 10000 (m^2))/sectional area (m^2)]. It is expressed in t/ha;

- Harvest index (HI): HI in (%) measures the distribution of assimilates between harvested organs (seeds) and the rest of the plant (total biomass) and is expressed according to Manfred Huehn's formula:

HI (%) = [seed yield x 100 / (seed yield + forage yield)]. It is used to determine which accessions are suitable for forage or grain production.

The data collected was reported, reorganized and processed on Excel. An analysis of variance (ANOVA) was performed to assess the level of variability between accessions. Relationships between variables were studied using Pearson's total correlation matrix. Principal Component Analysis (PCA) was performed on all variables to highlight discriminating variables. Xlstat pro version 7.1 software was used for data analysis.

RESULTS AND DISCUSSIONS

Phenological stages

The results of the analysis of variance for all phenological variables are shown in Table 1. The analysis revealed a highly significant difference at the 5% level (P= 0.005) for the 95% maturity date. Indeed, maturity (Figure 1) occurred in the 53 to 65 JAS range, with an average of 59 JAS. Accessions M25, M09 and M32 were the earliest, with 53, 55 and 56 days to maturity respectively. The latest accessions are M40 and M42, which ripened at 62 JAS and M03 at 65 JAS.

Table 1. Results of analysis of variance of phenological parameters for ten (10) mung bean accessions

Accessions	50% Emg (JAS)	50% Flo (JAS)	95% Mat (JAS)
M42	6 ^{a}	42 ^{a}	62 ^{ab}
M06	7 ^{a}	38 ^{a}	58 ^{abc}
M40	5 ^{a}	41 ^{a}	62 ^{ab}
M38	8 ^{a}	41 ^{a}	59 ^{abc}
M25	4 ^{a}	37 ^{a}	53 ^{a}
M03	4 ^{a}	43 ^{a}	65 ^{a}
M31	5 ^{a}	39 ^{a}	59 ^{abc}
M09	4 ^{a}	37 ^{a}	55 ^{abc}
M16	4 ^{a}	39 ^{a}	59 ^{abc}
M32	4 ^{a}	36 ^{a}	56 ^{abc}
Minimum	4	36	53
Maximum	8	43	65
Average	5	39	59

CV	45	10	7
R^2	0,43	0,36	0,64
Pr > F	0.158ns	0.319ns	0,005**

Note: a, b and c: classes of values resulting from comparison by the Newman and Keuls test such that a>b>c. Means assigned the same letter in the same column are not significantly different at the 5% threshold (P< 0.05). 50% Emg: 50% emergence; 50% Flo: 50% flowering; 95%: 95% maturity; DAS: Days After Sowing; Cv= coefficient of variation; R^2= Coefficient of determination; Pr > F: Fisher's F probability; (**) = highly significant; ns=not significant.

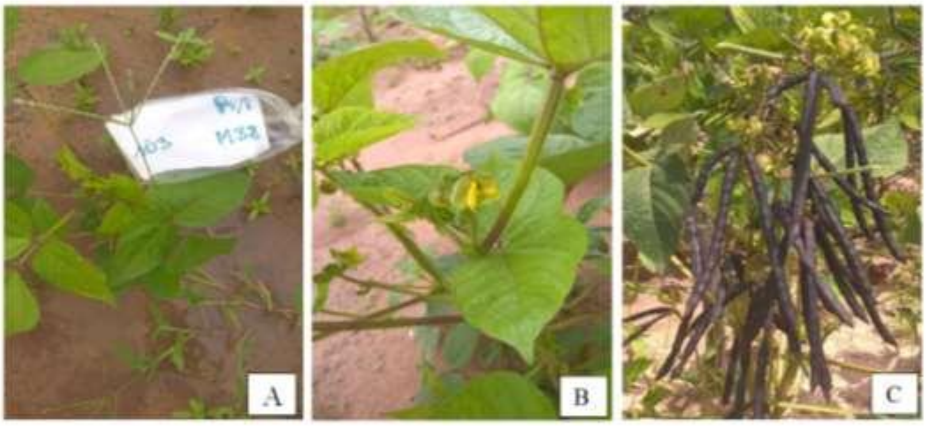

Figure 1. Mung bean phenological stages during the trial; A: growth stage; B: flowering stage; C: maturity stage.

Seed yield and its components

Table 2 presents the results of the analysis of variance of the variables related to yield and its components. Plant height ranged from 29.12 to 51.39 cm, with a mean of 40.34 cm. Analysis of variance revealed a highly significant difference (P < 0.0001). The lowest height value was noticed in accession M16 (29.12 cm), while the highest value was obtained in accession M06 (51.39 cm).

The number of pods per plant ranged from 25 to 114, with an average of 52 pods per plant. Analysis of variance showed a highly significant difference (P = 0.0001). The lowest value for the number of pods was obtained with accession M16 (25), while the highest average number of pods per plant was recorded with accession M42 (114). Stem diameter ranged from 7.55 to 12.77 mm, with an average of 9.24 mm. The strongest accession was M42 (12.77 mm). Accession M16 was the least robust (7.55 mm). Analysis of variance showed a highly significant difference at the 5% threshold (P = 0.001). For pod weight, analysis of variance revealed a significant difference at the 5% level (P = 0.014). Pod weights ranged from 122.67g (M32) to 449.67g (M06 and M25), with an average of 317.22g.

The 1000-seed weight parameter ranged from 20 g (M03) to 40.67 g (M38), with an average of 30.57 g. Analysis of variance revealed a highly significant difference (P = 0.000) for this parameter.

Seed weight per elementary plot ranged from 48 g (M32) to 354 g (M06), with a mean of 213.4 g. Analysis of variance revealed a highly significant difference at the 5% threshold (P = 0.006) for this parameter.

The seed yield obtained ranged from 0.48 t/ha (M32) to 3.54 t/ha (M06), with an average of 2.13 g. For this parameter, the analysis of variance revealed a highly significant difference between accessions (P = 0.006).

Table 2. Results of the analysis of variance of seed yield and its components for 10 mung bean accessions

Accessions	HP (cm)	Nb G/plt	DT (mm)	PG (g)	P1000 gr (g)	Pgr (g)	Rdt gr (t/ha)
M42	51,37 a	114 a	12,77 a	393 ab	23 c	306 ab	3.06 ab
M06	51,39 a	59 bc	10.23ab	449,67 a	32 abc	354 a	3,54 a
M40	41.78 ab	74 b	10.96ab	191.33 ab	30 abc	91 ab	0.91 ab
M38	40.11 abc	29 c	9,44 b	299 ab	40,67 a	174 ab	1.74 ab
M25	41.39 ab	69 bc	9,57 b	449,67 a	36 ab	340 a	3,4 a

M03	30.49 bc	41 bc	8,05 b	401 ab	20 c	291 ab	2.91 ab
M31	37.41 bc	43 bc	7,61 b	388.67 ab	39,67 a	288 ab	2.88 ab
M09	42.62 ab	40 bc	8,29 b	225 ab	29.67 abc	115 ab	1.15 ab
M16	29,12 c	25 c	7,55 b	252.33 ab	29.33 abc	127 ab	1.27 ab
M32	37.77 bc	28 c	7,94 b	122,67 b	25.33 bc	48 b	0,48 b
Minimum	**29,12**	**25**	**7,55**	**122,67**	**20**	**48**	**0,48**
Maximum	**51,39**	**114**	**12,77**	**449,67**	**40,67**	**354**	**3,54**
Average	**40,34**	**52**	**9,24**	**317,23**	**30,57**	**213,4**	**2,13**
Cv	**20,05**	**57,07**	**21,18**	**45,58**	**24,81**	**64,85**	**64,85**
R2	**0,77**	**0,78**	**0,70**	**0,59**	**0,75**	**0,63**	**0,63**
Pr>F	**< 0,0001*** **	**< 0,0001*** **	**0,001*** **	**0,014***	**0,000*** **	**0,006** **	**0,006** **

Note: a, b and c: classes of values resulting from comparison by the Newman and Keuls test such that a>b>c. Means with the same letter in the same column are not significantly different at the 5% threshold (P< 0.05). HP: Plant height in cm; NbG/plt: Number of pods per plant; DT: Stem diameter in mm; PG= Pod weight in g; P1000gr: Weight of 1000 seeds in g; P gr: Seed weight in g; Rdt gr: Seed yield in t/ha; Cv= Coefficient of variation in %; R^2= Coefficient of determination, Pr > F: Fisher's F probability; (*) = significant, (**) =highly significant, (***) = very significant.

Foliage weight and forage yield

Results of the analysis of variance for weight and forage yield are shown in Table 3. Foliage weight ranged from 60 g to 315 g, with an average of 180.77 g. Forage yield ranged from 0.60 t/ha to 3.15 t/ha, with an overall average of 1.80 t/ha. The best weights and forage yields were obtained with accession M40 (315 g haulm weight and a forage yield of 3.15 t/ha) and the lowest with accession M32 (60 g haulm weight and a yield of 0.6 t/ha). Analysis of variance revealed a highly significant difference between accessions for these two parameters (P = 0.001).

Table 3. Results of analysis of variance of forage yields and foliage weights of ten mung bean accessions

Accessions	PF (g)	Rdt F (t/ha)
M42	250 abc	2.50 abc
M06	88 cd	0.88 cd
M40	315 a	3,15 a
M38	140 bcd	1.40 bcd
M25	107 cd	1.07 cd
M03	166.67 abcd	1.67 abcd
M31	134 bcd	1.34 bcd
M09	285 ab	2.85 ab
M16	262 abc	2.62 abc
M32	60 d	0,60 d
Min	60	0,6
Max	315	3,15
Average	180,77	1,80
CV	56,81	56,81
R^2	0,72	0,72
Pr > F	0,001***	0,001***

Note: a, b and c: classes of values resulting from comparison by the Newman and Keuls test such that a>b>c Means assigned the same letter in the same column are not significantly different at the 5% threshold (P< 0.05). PF: Fodder weight in g; Rdt F: Fodder yield in t/ha; Min: minimum; Max: maximum; Avg: mean; Cv= Coefficient of variation in %; R^2= Coefficient of determination; Pr > F: Fisher's F probability; (***) = very significant.

Harvest index

Table 4 shows the results of the analysis of variance of the harvest index. Analysis of variance revealed a highly significant difference (P < 0.0001) between accessions for the harvest index. It ranged from 22.74% to 78.89%, with a mean of 52.92%. The highest harvest index was observed in accession M06 (IR= 78.89%) and the lowest in M40 (IR= 22.74%).

Table 4. Results of the analysis of variance of the harvest index of ten (10) mung bean accessions

Accessions	IR (%)
M42	53,54 c
M06	78,89 a
M40	22,74 e
M38	55,71 c
M25	76,91 a
M03	64.19 bc
M31	67,67 b
M09	27,99 e
M16	38,61 d
M32	42,92 d
Min	22,74
Max	78,89
Avg	52,92
CV	36,63
R^2	0,95
Pr > F	< 0,0001***

Note: a, b and c: classes of values resulting from comparison using the Newman and Keuls test such that a>b>c Means assigned the same letter in the same column are not significantly different at the 5% threshold (P< 0.05). IR= Harvest Index in %; Min: minimum; Max: maximum; Avg: mean; Cv= Coefficient of variation in %; R^2= Coefficient of determination; Pr > F: Fisher's F probability; (***) = very significant.

Study of correlations

Table 5 illustrates the correlations obtained between the different variables studied. The variable number of days of 50% flowering was highly significant and positively correlated with the number of days of 95% ripening (r = 0.89). The 95% maturity variable was significantly and positively correlated with haulm weight (r = 0.36) in the first instance and with forage yield (r = 0.36) in the second; however, it proved to be significantly and negatively correlated with 1000-seed weight (r = -0.44). A positive and highly significant correlation between variables such as plant height and stem diameter (r = 0.70) were observed. Similarly, plant height correlated very significantly and positively with the number of pods per plant (r = 0.70). Withdrawal weight was highly significant and positively correlated with forage yield (r = 1). On the other hand, it was negatively and significantly correlated with seed yield (r = -0.35). Seed weight was positively and very significantly correlated with seed yield (r = 1). On the other hand, it was negatively and significantly correlated with forage yield (r = -0.35). Seed yield was very significantly and positively correlated with the harvest index (r = 0.88). However, forage yield was very significantly and negatively correlated with the harvest index (r = -0.74).

Table 5. Pearson correlation matrix between studied traits

Variables	50% Emg(JAS)	50% Flo (JAS)	95% Mat (JAS)	HP (cm)	Nb G/plt	DT (mm)	PG (g)	PF (g)	P1000 gr (g)	P gr (g)	Rdt gr (T/ha)	Rdt F (T/ha)	IR (%)
50% Emg(JAS)	1												
50% Flo	0.26	1											

(JAS)													
95% Mat (JAS)	0.15	0.89***	1										
HP (cm)	0.60**	-0.12	-0.2	1									
Nb G/plt	0.21	0.32*	0.2	0.70**	1								
DT (mm)	0.48*	0.39*	0.27	0.70**	0.88***	1							
PG (g)	0.28	0.27	0.04	0.29	0.40*	0.27	1						
PF (g)	-0.13	0.39*	0.36*	-0.04	0.29	0.25	-0.31	1					
P1000 gr (g)	0.44*	-0.28	-0.44*	0.08	-0.25	-0.15	0.17	-0.25	1				
P gr (g)	0.27	0.23	0.04	0.36*	0.45*	0.31*	0.99***	-0.35*	0.11	1			
Rdt gr (T/ha)	0.27	0.23	0.04	0.36*	0.45*	0.31*	0.99***	-0.35*	0.11	1.00***	1		
Rdt F (T/ha)	-0.13	0.40*	0.36*	-0.04	0.29	0.25	-0.31*	1.00**	-0.25	-0.35*	-0.35*	1	
IR (%)	0.26	-0.01	-0.14	0.19	0.11	0.05	0.87***	-0.74**	0.26	0.88***	0.88***	-0.74**	1

Note: values in bold are different from 0 at a significance level of 5%. 50%Emg (JAS): number of days after sowing to 50% emergence; Flo (JAS): number of days after sowing to 50% flowering; Mat (JAS): number of days after sowing to 95% maturity; HP: plant height; Nb G/plt: number of pods per plant; DT: stem diameter; PG: pod weight; PF: haulm weight; P1000 gr: weight of 1000 seeds; P gr: seed weight; Rdt gr: seed yield; Rdt F: forage yield, IR: harvest index, (*) = significant, (**) = highly significant, (***) = very significant.

Principal Component Analysis

Principal component analysis (PCA) performed based on the 13 variables showed that the first two axes (Figure 2) are the main ones, as they explained 65.64% of the total variability between the accessions studied. The variables were randomly distributed in the plane. Axis 1, with 38.04% of total inertia, positively associating the variables pod weight (r = 0.92), seed weight (r = 0.95), seed yield (r = 0.95), harvest index (r = 0.91) (Table 5); thus can be defined as the graniferous production axis. Axis 2 accounted for 27.60% of the total variance and positively associated the variables 50% flowering date (r = 0.73), 95% maturity date (r = 0.67), number of pods per plant (r = 0.72), stem diameter (r = 0.73), haulm weight (r = 0.74), forage yield (r = 0.74); it can be defined as the forage production axis.

The significant differences between minimum and maximum values, the different correlations between variables, and the structuring and characterization of accessions all point to significant genetic variability and a wide range of agronomic and forage diversity of interest to breeding and varietal selection programs.

The significant difference for the 95% maturity date variable may indicate that the accessions have different cycles. The 95% maturity date of these accessions, located between the 53rd and 65th days after sowing, is close to that of lines developed by the World Vegetable Center (AVRDC) in Tanzania in 1990. These lines had an early maturity cycle between 55 and 65 days after sowing. This variation in maturity is thought to be linked to climatic conditions or the genetic makeup of the genotypes tested (Singh et al., 2010). In addition, Trung et al (1985) classified mung bean varieties according to their maturity cycle into three groups: early-cycle varieties (60 to 70 days), intermediate-cycle varieties (70 to 80 days) and late-cycle varieties (over 80 days). Based on this classification, mung bean accessions maturing at 95% in less than 60 days (M06, M09, M16, M25, M31, M32, M38) could be considered extra-early-cycle accessions, and accessions (M03, M40, M42) maturing between 60 and 65 days, early-cycle accessions. In view of the earliness of the accessions studied, the latter are of great agronomic interest, as they could help to cope with short rainy seasons and end-of-season drought in areas where climatic conditions are not favourable (Sawadogo, 2020).

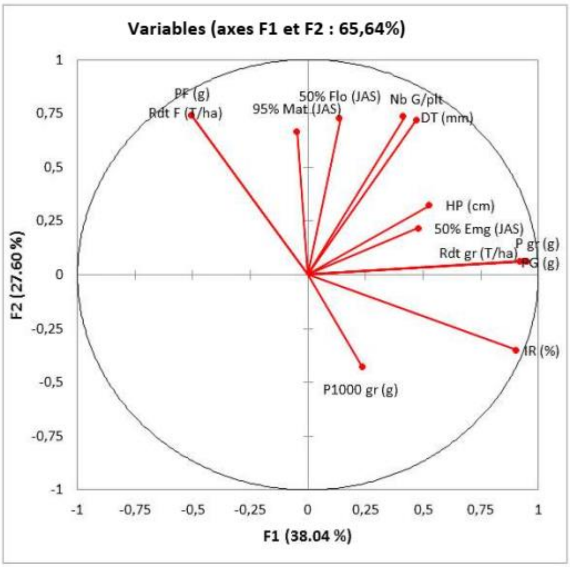

Figure 2. Representation of variables in the plane of axes 1-2 of the Principal Component Analysis.

As for the number of pods per plant, the highly significant and positive difference observed between accessions can be explained by the fact that this parameter is a determining factor in mung bean selection. In their work in Navsari, India, Dhoot et al. (2017) found that the number of pods per plant exerted the greatest direct effect on seed yield. As a result, they reported that in order to select high-yielding mung bean cultivars and increase seed yield, this parameter should be taken into account. Considering these aspects, accessions M42, M06, M25, M03, and M31 would be the best accessions given their high pod counts. The very significant difference in harvest index observed between accessions would mean that the quantity of biomass produced would differ from one accession to another. Accessions with the highest harvest indexes achieved higher seed yields than forage yields. This would indicate that seed yield has a direct effect on harvest index, hence the highly significant correlation observed between these two variables. According to Diatta et al. (2020), in their study carried out in Senegal, this would imply genetic variability, as nutrients were used differently in the efficiency of assimilate mobilization towards reserve structures. The same authors argued that this variable makes it possible to adjust farming practices according to the specific genetic yield performance of each accession or variety and enables them to be better utilized.

According to Hazra and Basu (2000), correlation coefficients provide insight into the intensity of associations among variables. Thus, correlation studies provide information on the nature and extent of association between any two pairs of metric traits. As such, it may be possible to bring about genetic improvement of a trait by choosing one or the other pair. Thus, the significant positive correlations among some of the agronomic and forage variables observed in this study suggest that traits could be improved simultaneously without any offsetting negative effects. For example, the positive correlation between 50% flowering date and 95% maturity date suggests that these variables are moving in the same direction. This would mean that the 95% maturity date could be predicted from the 50% flowering date. The significant positive correlation observed between plant height and the number of pods per plant, and between plant height and stem diameter, means that these variables move together. In the sense that the greater the plant height, the more pods the plant can form, and the better it can support them with a robust stem. Indeed, the plant needs a certain vigour and robustness to be able to support the pods that form as the plant grows, thus increasing in height. Mwangi et al. (2021), having worked on mung bean varieties in Kenya, have pointed out that plant height is crucial, as it determines the plant's ability to absorb carbon, maintain good vigour and subsequently enable good maturity and ensure a good lifespan, a trait preferred by farmers. These results are similar to those of Makeen et al. (2007) in their work in India and Muthuswamy et al. (2019) in their work undertaken in South Asia. These authors stipulated that these traits would be linked to the actions of additive genes and should be subject to selection as they would be crucial components of yield.

Principal Component Analysis revealed that the agronomic and forage performance of accessions would be structured by phenological variables and yield components. Projection of the variables in PCA planes 1-2, which contributed to 65.63% of the variability, showed a random distribution of the variables. This dispersion would indicate significant agronomic and forage variability. The significant variability was achieved by the variables 50% flowering date, 95% maturity date, number of pods per plant, stem diameter, haulm weight, pod weight, seed weight, seed yield, forage yield and harvest index. These traits would also be those that contribute most to the notion of yield and those that discriminate most between the accessions studied. Our results are similar to those found by Yoseph (2022) in Ethiopia, who stated that the present variables are among the most desirable and monitored as yield components by farmers.

CONCLUSIONS

The present study showed the existence of great variability within the mung bean accessions studied. Principal Component Analysis revealed that the variables studied, namely 50% flowering date, 95% maturity date, number of pods per plant, stem diameter, haulm weight, pod weight, seed weight, seed yield, fodder yield and harvest index, contributed most to the notion of yield. This evaluation enabled us to identify accessions with characteristics of agronomic interest and those of forage interest. The number of pods plays an essential role in the selection of accessions. In this aspect, accession M42 obtained the highest number of pods and could be proposed to growers. Group 2 accessions M40, M38, M09 and M16, on the other hand, showed the best forage performance. Accession M40 was the most productive in terms of forage yield. Accession M42 showed good agronomic and forage performance, with an early date of maximum maturity, the highest number of pods and good seed and forage yields. It can therefore be used for dual purposes and recommended to farmers, livestock breeders and agro-pastoralists. It could also be the subject of selection and extension. Most of the accessions studied had fairly short production cycles. These extra-early and early accessions, productive in seed and fodder, could thus be substitutes for certain cultivated cowpea varieties. They constitute a range of very interesting accessions that can be used for a variety of production purposes. They could therefore be proposed for more in-depth study, with a view to submitting them to producers and consumers for assessment, in order to improve mung bean production, food self-sufficiency, nutritional security and greater resilience in the context of climate change.

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Conflicts of Interest

The authors declare that they do not have any conflict of interest.

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