EVALUATING GROWTH PERFORMANCE OF TWO MUNGBEAN (*VIGNARADIATA (L) WELCZEK*) VARIETIES TO TILLAGE PRACTICES AND SOWING METHODS IN SOUTHERN SAVANNA AGRO-ECOLOGY OF NIGERIA

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Abstract
The experiment was conducted at the Plateau State College of Agriculture, Garkawa (Latitude $10^0$11'N and longitude $8^0$21'E in the Southern Guinea Savanna in 2015 and 2016 wet seasons to evaluate growth performance of two mungbean varieties (Galadima and Ingalab), sowing method (dibbling, drilling and broadcasting) and tillage practice (Ridge, flat, strip). The experiment was laid on a strip split plot design with tillage practice arranged on the vertical strip, sowing method on the horizontal strip and variety in the intersection and subplots, replicated 3 times. The results obtained on the main effects showed that the use of ridges, dibbling or drilling and Ingalab varietyhad superior ($P\leq 0.05$) tillage practice, sowing methods and variety. Mungbean growth characters like plant height, leaf area index, net assimilation rate and crop growth rate indicated no interactions at different level. Highest leaf area index, net assimilation rate and crop growth rate were obtained for variety inqalab grown on ridges using dibbling sowing methods (2.03, 2.03, 4.50) which was at par with drilling sowing method and lowest with strip tilled plot using broadcast sowing method (0.49, 0.47, 1.30) respectively. Based on these findings, the use of inqalab variety grown on ridges using dibbling or drilling sowing methods showed promise for optimum growth of mungbean to farmers under agronomic condition in Garkawa.
Keywords: **Mungbean production, sowing methods, tillage practices, varieties, growth yield**

Introduction
Mungbean (*Vigna radiate (L) Welczek)* is a bean grown in Nigeria since early sixties (Falaki et al, 1987). Mungbean provides protein to African dishes which are mostly starch in nature. As a grain legume, it is of considerable importance not just as a major source of protein in human nutrition but equally used as feed for animal nutrition. Furthermore, it is of a particular advantage in mixed cropping, crop rotation and as soil fertility enhancer due to its ability to grow and perform optimally in nitrogen deficient soil (Allotey and Oyewo, 2000).

Over the years, production of Mungbean in Nigeria has been in the hands of small holder farmers whose income is far below one dollar a day (World Bank, 2010). Despite its economic importance, there are many hindrances to promotion of this crop. Among these obstacles are the dearth of research work to address low yields, suitable varieties to be grown in a given area right sowing methods, limited capacity to improve yields and quality through better tillage practices.

Due to inadequate knowledge on its basic management practices, most farmers have resorted to their traditional cultural practices. This has led to the inability to harness optimum yields in the area of study. The *Galadima* variety is reported to have poor yields of 537kg/ha (Zitta, 2004). The need for a short duration improved variety to replace poor yielding local suitable varieties in the area cannot be overemphasized. Since there is scarcity of land and other production resources at the disposal of the rural poor farmer, the desire to improve the mungbean yields through simple, adaptable and sustainable techniques cannot be overemphasized.

Materials and Methods

Investigations were carried out during 2015 and 2016 rainy seasons at Garkawa ($10^0$11'N, $8^0$21'E 690m above sea level) to evaluate the growth performance of two mungbean varieties G*aladima, Ingalad* (sourced from the National Seed Council) in the Southern Guinea ecological zone of Nigeria. The total rainfall received during the period was 1031.6mm in 2015 and 1066.3mm in 2016. The soil of the experimental site was sandy loam which was characterized by low organic carbon (0.29 and 0.61) in 2015 and 2016 respectively available phosphorus (143.5 and 112/205) and total nitrogen (0.056 and 0.06g kg/ha). The treatments consisted of two mungbean varieties (*Galadima and Ingalab*). *Galadima* is a local variety, while Ingalab is a hybrid variety, a cross between VC1482C and NM92-A). The treatments were arranged in all possible combinations and laid out in a strip split plot design with 3 replications.

	T1	**T2**	**T3**		**T3**	**T2**	**T1**		**T3**	**T1**	**T2**
	V2	V1	V2		V2	V1	V1		V2	V2	2
S1	V1	V2	V1	S3	V1	V2	V2	S2	V1	V1	V1
	V2	V1	V1		V1	V2	V2		V1	V2	V2
S2	V1	V2	V2	S1	V2	V1	V1	S3	V2	V1	V1
	V1	V2	V2		V2	V2	V2		V1	V1	V2
S3	V2	V1	V1	S2	V1	V1	V1	S1	V2	V2	V1

A sample layout of a 3X3X2 factorial experiment arranged in a strip split plot design with three tillage practices (T1, T2 and T3) as vertical treatments, there sousing methods (S1, S2 and S3) as horizontal treatments and two varieties (V1 and V2) as sub plot treatments, in three replications.

Each variety has a treatment and grown for 3 months in each year. portion of the experimental site was prepared by disc plough, harrowed and ridged at 75cm apart. Another replicate (6m2) was ploughed, harrowed but levelled flat, whereas another replicate (6m2) was strip tilled i.e. for the purpose of sowing the crop only a strip (line) was tilled whereas between the rows, the land was left untilled. The field was then marked into 54 plots of (2x2) m each. A path of 1m across and 1m along the rows were allowed separating adjacent plots. The total land area was 220 Three seeds were sown, manually at 4.2cm intra-row spacing and thinned to 2 plants per hole, 14days after emergence. A phosphate fertilizer SSP (18% $P2^05$) was applied by banding method immediately after planting before at a spacing of 7.5cm x 4.2cm for each variety germination at the rate of 10kg p/ha. Weeds were controlled using pendimethalin pre-emergence herbicide at the rate of 440g/ha. A supplementary hoe weeding was carried out at 3 weeks after sowing to control seed weeds. Furadan at the rate of 0.6kg/ha in 300 litres of water was used to control fungi and lamda cyhalothrin was used to control insect pests at the rate of 0.80 letres/ha, harvesting was carried out immediately the pods turned black, which is a sign for physiological maturity.

The data collected on growth characteristics were subjected to Genstat 7.0 statistical package and significant differences among the treatment means were evaluated using Duncan Multiple Range Test (Duncan, 1955).

Result and Discussion

Table 1: Physico-chemical properties of the soil collected from the experimental site in 2015 and 2016

Soil Characteristics	Composition	
	2015	2016
% sand (fine)	24.40	18.36
% sand (coarse)	46.56	50.04
% clay	19.65	25.70
% silt	64.90	57.80
Textural Class	Sandy Loam	Sandy Loam
Chemical properties		
PH (H_2O)	5.37	5.66
Carbon %	0.29	0.61
Organic matter (%)	0.50	1.05
Available $P_2{}^05$ (PPM)	143.5	112
Total nitrogen (%)	0.056	0.06
Exchangeable cations meg/100g soil		
Ca	1.65	1.14
Mg	1.08	1.42
K	0.27	0.26
Na	4.40	3.78
CEC	8.22	7.45

Table 2: Influence of tillage practices, sowing method and varieties on plant height (cm) of mungbean grown during the 2015 and 2016 wet seasons in Garkawa

Treatment	2015	2016
Tillage Practices(T)		
Ridge	29.61^a	34.12^a
Flat	25.30^b	34.11^a
Strip	20.01^c	21.02^b
SE(±)	1.841	1.432
Sowing Methods(s)		
Dibbling	20.22^b	28.68^b
Drilling	28.12^a	35.70^a
Broadcast	28.13^a	35.61^a
SE(±)	0.921	1.021
Variety (VI)		
Galadima	18.1^{ab}	25.30^b
Ingalab	20.16^a	29.61^a
SE(±)	0.856	0.432
Interaction		
IXS	NS	NS
SXV	NS	NS
TXV	NS	NS
TXSXV	NS	NS

Means followed by different letters within a treatment group are significantly different following DMRT. NS= Non significant

In 2015 and 2016, tillage practice/sowing method and variety significantly affect plant height. It shows that the use of ridge was significantly superior to flat, similarly, the use of flat was significantly superior to strip tilled tillage practice (Table 2). This could be due to the fact that the use of ridges facilitates higher drainage and make aeration in the soil possible.

Sowing methods (Table 2) in the two years indicated significant differences ($P \leq 0.05$). The use of broadcast sowing method and drilling were at par in both years of the trial. The use of dibbling method was significantly inferior to broadcast and drilling. This could be due to the ability of the crops to compete for sunlight with higher number of plants per plot. This agrees with the findings of Aslam (2004) who reported that when mungbean plants exceed 40stands in a square metre, they compete for sunlight.

Ingalab variety was significantly higher in both years of the trials than *Galadima* ($P \leq 0.05$). *Galadima* variety is a local variety which is less sensitive to management practices. *Ingalab* on the other hand is a hybrid variety which married the combine characteristics of VC1482-C and NM 92A. This genetic makeup leads to superior plant height. This finding is however contrary to the work of KO (1977) who reported that hybrid varieties of mungbean were superior to local as ascensions significant interactions were not seen in both years.

Table 3 shows the influence of tillage practices, sowing methods and varieties on leaf area index of mungbean grown during 2015 and 2016. It shows that growing mungbean on ridges was significantly superior to flat. The use of strip tillage was however superior in both years of the experiment. This could be due to the ability of the crops grown on ridges to harness photosynthesis better, since they are well distributed and spaced within the plot to access photosynthesis better through their leaf pans. This is similar with the work of Trung and Yoshida (1982) who reported lower leaf area index with the use of zero tillage due to competition for other nutrients. The use of diblling and drilling sowing methods were at par but superior ($P \leq 0.05$) to broadcast method. This was because broadcast planting has higher plant population leading to tiny stems and leaves.

Ingalab variety gave higher leaf area index. Probably due to genetic makeup of the plant. Significant interactions were not observed between the factors in the two years.

Table 3: Influence of tillage practices, sowing methods and varieties on leaf area index of mungbean grown during 2015 and 2016 wet seasons in Garkawa

Treatment	**2015**	**2016**
Tillage practice (T)		
Ridge	1.17[a]	1.36[a]
Flat	0.50[b]	0.62[b]
Strip	0.49[b]	0.61[b]
SE (±)	0.087	0.091
Sowing methods(s)		
Dibbling	0.76[a]	1.48[a]
Drilling	0.76[a]	1.46[a]

Broadcast	0.25[b]	1.01[b]
SE (±)	0.087	0.091
Varieties		
Galadima	18.19[b]	25.30[b]
Ingalab	20.15[a]	29.62[a]
SE (±)	0.856	0.432
Interaction		
TXS	NS	NS
SXV	NS	NS
TXV	NS	NS
TXSXV	NS	NS

Means followed by different letters within a treatment group are significantly different following DMRT. NS = Non-Significant

Table 4 shows the effect of tillage practices, sowing methods and varieties ofmungbean in 2015 and 2016. It shows that there was significant effect among tillage practices, sowing methods and varieties in both years of the experiment. Ridge tillage was superior to flat and strip. The significant differences noted could be due to less competition for nutrients, air and water between the crops and weeds. This is in harmony with the findings of Jigo (1987) who reported superior net assimilation rate in cow pea.

Significant differences noted in sowing methods could be due to differences in plant population and spacing between plants wider spacing in the use of dibbling or drilling led to less competition between plants and higher light interception and assimilation synthesis. This result is in harmony with Amer *et al*, (2010) who reported that all vegetative growth parameters were significantly increased, by different sowing methods. Significant differences in varieties could be due to genetic differences and response of varieties to soil conditions. Interactions were not observed between factors in the two years.

Table 4: influence of tillage practices, sowing methods and varieties on net assimilation rate (g/cm^2) of mungbean grown during 2015 and 2016 wet seasons in Garkawa

Treatment	2015	2016
Tillage practice (T)	2015	2016
Ridge	16.14[a]	18.14[a]
Flat	14.16[b]	15.49[b]
Strip	10.70[c]	12.58[c]
SE (±)	0.119	1.711
Sowing methods(s)		
Dibbling	19.51[a]	23.51[a]
Drilling	19.49[a]	23.50[a]
Broadcast	17.04[b]	17.85[b]
SE (±)	0.140	0.149
Variety		
Galadima	14.16[b]	15.49[b]
Ingalab	16.12[a]	18.12[a]
SE (±)	0.139	0.150

Interaction		
TXS	NS	NS
SXV	NS	NS
TXV	NS	NS
TXSXV	NS	NS

Means followed by different letters within a treatment group are significantly different following DMRT. NS= Non-significant.

Table 5: Influence of tillage practices, sowing methods and varieties on crop growth rate (g/cm^2) of mungbean during 2015 and 2016 wet seasons in Garkawa.

Treatment **Tillage practice (T)**	**2015**	**2016**
Ridge	16.13^a	18.14^a
Flat	14.15^b	15.50^b
Strip	10.69^c	12.58^c
SE (±)	0.119	1.710
Sowing methods(s)		
Dibbling	19.50^a	23.49^a
Drilling	19.50^a	23.49^a
Broadcast	17.03^b	17.83^b
SE (±)	0.140	0.148
Variety		
Galadima	14.15^b	15.50^b
Ingalab	16.11^a	18.11^a
SE (±)	0.139	0.150
Interaction		
TXS	NS	NS
SXV	NS	NS
TXV	NS	NS
TXSXV	NS	NS

Means followed by different letters within a treatment group are significantly different following DMRT. NS= Non-significant.

The response of crop growth rate base on tillage practices of mungbean showed that, the use of ridges were significantly (P≤0.05) higher than flat and strip in both years. This could be due to the ability of ridge in promoting vegetative growth as fertilizers applied were properly channelled to the plants and assimilated for use by the plants. Similarly, significant increase in sowing methods could be attributed to a well-developed vegetative structure in dibbling and drilling over broadcast sowing methods. Dibbling and drilling sowing methods to spread their leaves properly and provides larger surface area for light interception and assimilate synthesis. Superior significant difference observed with *Ingalab* over *Galadima* could probably be due to genetic makeup of the plants. Interactions were not observed between factors in the two years.

Conclusion

It can therefore be concluded that the use of *Ingalab* variety grown on ridges using dibbling or drilling sowing methods was observed to be superior to other treatments applied, thus it is the most suitable combination for the growth of mungbean in Garkawa.

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