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INFLUENCE OF BEAN (*PHASEOLUS VULGARIS L.*) DENSITY ON MORPHO-PHYSIOLOGICAL AND YIELD PARAMETERS IN MENDANKWE NORTH WEST REGION OF CAMEROON

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ABSTRACT

Grain legumes as a protein-rich food, plays an important role in human nutrition, especially in developing countries. Beans contribute up to 33% of the dietary protein need of humans. The production of bean in Mendankwe is generally poor as a result of poor knowledge on the planting spacing of the bean plant. As a result of this, an experiment was conducted in Mendankwe from the 21 of February to the 30th of June to investigate the appropriate planting density of beans for; 10cm, 15cm, 20cm, 25cm and 30cm. Arandomized complete block designed with four replication was used. An experimental unit measuring 2.0 m by 1.0 m was used. Data on the emergence, plant height, vigorousity, and number of pods, pod length and the weight of grains were collected. Data were analysed and results presented in tables and Histogram. The results indicated that treatment one (10.0 cm) had the highest emergence rate with a total of 98% germination due to its highest population density and treatment five (30.cm) had the least germination with 82%. Treatment two (15 cm) gave the highest plant height of 28.3cm while treatment five (30 cm) had the least with 23.3cm. Treatment four with the planting spacing of 25cm is recommended to farmers in Mendankwe village since it had a very good percentage number of pods and consequently highest number of grains produced as compared to other plant density.

Key words: Common bean, spacing, yield, Mendankwe, Cameroon

RÉSUMÉ

Les légumineuses à grains, riches en protéines, jouent un rôle important dans l'alimentation humaine, notamment dans les pays en développement. Les haricots contribuent jusqu'à 33 % des besoins en protéines alimentaires de l'humanité. La production de haricots à Mendankwe est généralement faible en raison d'une mauvaise connaissance de l'espacement des plants. Par conséquent, une expérience a été menée à Mendankwe du 21 février au 30 juin afin d'étudier la densité de plantation appropriée pour les haricots : 10 cm, 15 cm, 20 cm, 25 cm et 30 cm. Un bloc complet randomisé avec quatre répétitions a été utilisé. Une unité expérimentale de 2,0 m sur 1,0 m a été utilisée. Des données sur la levée, la hauteur des plants, la vigueur, le nombre de gousses, la longueur des gousses et le poids des grains ont été collectées. Les données ont été analysées et les résultats présentés sous forme de tableaux et d'histogrammes. Les résultats ont montré que le premier traitement (10,0 cm) présentait le taux de levée le plus élevé, avec un taux de germination total de 98 %, en raison de sa densité de population la plus élevée. Le cinquième traitement (30 cm) présentait le taux de germination le plus faible, avec 82 %. Le deuxième traitement (15 cm) a donné la hauteur de plante la plus élevée, soit 28,3 cm, tandis que le cinquième traitement (30 cm) a obtenu

la plus faible, avec 23,3 cm. Le quatrième traitement, avec un espacement de plantation de 25 cm, est recommandé aux agriculteurs du village de Mendankwe, car il présentait un très bon pourcentage de gousses et, par conséquent, le plus grand nombre de grains produits par rapport aux autres densités de plantation.
Mots clés : Haricot commun, espacement, rendement, Mendankwe, Cameroun

I. INTRODUCTION

Grain Legumes, as a protein-rich food, play an important role in human nutrition, especially in developing countries. They contribute up to 33% of the dietary protein needs of humans (Vance et al, 2002). Common bean (Phaseolus Vulgaris) is a warm season annual legume crop, grown primary for its protein and energy -rich dry seeds. Bean grains are a good source of iron and zine (Burchara et al, 2011) and have a low glycemic index (Widers, 2006). Beans are an essential source of amino acids such as iron, copper and zine, and beneficial phytochemicals, antioxidants and flavonoids (FAO, 2009). Dry beans are typically processed before consumption, usually by cooking in water but some beans are consumed after roasting or after milling into flour (Siddiq and Uebersax, 2012). Immature seeds pods, called snap beans, are consumed as vegetables and straw from the plant is used as forage (Broughton et al, 2003). The leaves of some selected varieties are consumed as vegetable, usually when better quality food is not available (Wortmann, 2006).

In Cameroon, beans production is estimated at about 26,500 tons (New Agriculturist, 2012). Beans which was considered as "the poor man's meat" in Africa is nowadays classified as the most consumed dry leguminous plant in the world both by the poor and rich people due to its high nutritive protein content.In fact, due to its high interest to the population, beans is cultivated either as green beans or for its grains which is very high in plant protein in the human diet. Also, its stem and leaves are fed to livestock. Its leaves are also consumed in some countries in the form of vegetables. When its leaves and stems are buried in the soil, they contribute to the high organic matter content of the soil especially in Nitrogen (N).Bean production in Africa and Cameroon in Particular is not able to satisfy the demand of its fast growing population. In Cameroon, 90% of its production is from the West and North Regions with an altitude of 1000m and above, with a marginal production in regions of lower altitude (Anonymous, 2010). Bean production in Cameroon is estimated to above 700 to 800kg/ha which is relatively low as compared to that of foreign countries which is estimated at 3000kg/ha. One cause of low yield may be due to planting distances as there is no recommended planting distance to farmers in the different agro ecological zones for which the yield is at maximum. Lack of inadequate knowledge by our peasant farmers and the rapid rise in population, the demand for beans continues to increase exponentially. The aspect of spacing of this crop becomes unavoidable in order to increase its production. This research is aimed at finding out the effect of spacing on yield of the common bean and then recommends the best planting distance to farmers in Mendankwe. The present study seeks to find out the effect of plant spacing on the yield of common beasn in Mendankwe in the North West Region. This is due to inadequate knowledge on the cultivation of beans by farmers and as a consequence there is low yield.The Main Research Objective is to evaluate the influence of beans (*Phaseolus vulgaris* L)density on morpho-physiological and yield parameters in Mendankwe North West region of Cameroon.The specific objectives are to determine;the effect of planting distances on the yield of beans,the effect of planting distances on the Leave Area Index (LAI) of beans, the effect of planting distances on plant height of beans,the effect of planting distances on plant vigor of beans,the effect of planting distances on flowering of beans, the effect of planting distances on earliness of beans, the effect of planting distances on 100g weight of grains of beans

The significance of the research finding will range from the student, the farmer and the Cameroonian Government as a whole. This research is significant to me as a student as it is the final requirement for me to be awarded the Bachelor of Science degree in Agronomy. The research will act as the base or foundation for further research on the topic. The findings of this research will be able to recommend appropriate planting distance for the farmers of Mendank we and beyond for those in the same agro-ecological zone. This may be of great significance to them as it may help to improve on their yields and also to increase their yield of production.Furthermore, the research will be greatly significant to the Cameroonian government as the yield of beans is increased, it will help boost the economy and greater satisfaction to her fast growing population.

About 200 years ago, it was believed that common bean originated in Asia, a large body of evidence indicates that phaseolus vulgaris originated in the New World. Archaeological records indicate that the species originated and was first domesticated as early as 500BC (Bitochi et al, 2012 &2013). Although there is evidence for a more recent origin in Mesoamerica(Kaplan and lynch, 1999), multi-locus sequence data have indicated that the domestication of common bean was initiated 800 years ago (Mamidi et al, 2011).Polymorphisms among cultivated varieties and molecular markers, Isozymes and variant of the seed protein phaseolin, indicate that there may have been at least two independent centers of domestication in Central and South America (Bitocchi et al, 2013; Chaco et al, 2005; Bellucci et al, 2014) resulting in the middle American and the Andean gene pools had diverged before domestication effort began (Brucher, 1998; Delgadosalinas et al, 1998). The South American types tend to have seed and leaves of larger size than the

Central American varieties (Wortmann, 2006). Cultivated common bean were developed from wild common bean and domestication has introduced severally agronomically useful traits; indeterminate and bush types, increase leaf, pod diversity of seed size and suppression of pod dehiscence and seed dormancy. Vast diversity of seed size, shape and colour has also resulted from domestication (sing et al, 1991: brighten et al, 2003). Crop earliness has been enhanced by selecting for photo period insensitivity (white and Laing, 1989). Domestication of common bean has also resulted on a significant reduction in genetic diversity, compared to the species in the wild (Biocchi et al 2013; Chacon et al 2005). Spanish and Portuguese explorers eventually brought phaseolusvugaris to Europe in the 16th century (Purseglove 1968) and Portuguese traders are believed to have brought beans to Africa, where they spread from the highland areas of Central Africa to the rest of the continent (Wortmann, 2006), It was introduced in West Africa where it was then spread all over Africa(Wortmann, 2006).

The genus phaseolus in large, including approximately 80 cultivated and wild species, but phaseolus vulgaris is the most widely cultivated species (Freytag Debouck, 2002; Bailey, 2013). The most closely related species to phaseolusvulgaris are phaseolusalbenscens, phaseoluscocineus, phaseoluscostaricensis, phaseolusdumosus, P. Parvifolius and P.Persistentus, P. vulgaris belong to the Pabaleae family, which comprise species displaying a wide variety of forms: trees, shrubs and herbs; including many with climbing growth habit. Most species bear five petaled flowers with a distinctive papilionaceous or butterfly-like shape. The flower has a single large uprite petal, flanked by two horizontal 'wing' petals and subtended by two petals at the bottom of the flower, partially for complete joined to form a boat-like "keel', P.vulgaris shares many of the features characterizing the family, but two features distinguish the entire phaseolus genus from the rest of the family; the keel of the flower terminates in a coil, having from 1 to 2 turns and uncinated hairs are present on both the vegetative and reproductive structures of the plant (freytah and Debouck); the wild ancestor of p. vulgaris has been referred to as the same species, as a variety of domesticated common bean, p. vulgaris var. Maxicanusas a separate specie. P. arborigineus and as a sub species, P. vulgaris sub species. Arborigineus(El-Deep, 1999).

The Botanical Description of Bean (By IT IS, 2014) is presented below;

Roots: Its main roots could go up to 1.3m deep in the soil, but the majority of its roots are found around 0.2m and 0.25m deep on a diameter of 0.5m around the stem. Nodules can also be forms on its roots depending on the fertility of the soil.

Stem: the height of the stem depends on the variety; climbing beans could reach a height of about 2-3m and short ones have a height of 30cm to 40cm.

Leaves: Its first leaves are simple and two in number. The next leaves are trifoliate, spherical, green and about 10cm-12cm in length with each ending with a sharp end. These leaflets are attached to a petiole of about 12cm in length.

Inflorescence and Flowers: Its flowers are formed in clusters of about 5-15 flowers with an average of 10-15 cluster of flower per plant. Its flowers are of the type papihinaceae and are made up of five sepals and two petals and vary greatly in colours. They could be white, pink, red, violet or yellowish in colours.

Fruits and grains: Their fruits are elongated and are of various lengths depending on the variety, with an average of about 4-8grains enclosed. Their pods contribute to about 40-455 of the fruit weight. Their grains can be spherical or cylindrical depending on the variety, with colours which could be white, green, red, brown andblack. Beans has various vegetative phases which are; the growth phase, flowering phase that takes about 1 to 1 month and the maturity phase that takes 3 to 3 months.

Beans evolved in areas where taller vegetation limits sunlight that reaches the forest floors wild bean grows as a vigorous vine that enables it to effectively compete for sunlight (Beebe et al, 2014) a characteristic that enables it to effectively exploit disturbed site, using other pioneer species as climbing support (Delgado Salinas et al. 1988). Cultivated varieties of beans do not tend to persist as feral population in regions outside the species native range. Genetic analyses of individual bean plant selected from feral population, rather than the other ways around (Porch et al, 2013; Beebe et al, 1997; Torochi and Ocampo, 2004).

Phaseolus vulgaris is planted in pure stands of single land races, as mixed planting of several land races and intercropped with maize, sweet potatoes, cotton, coffee and other crops. (Wortmann, 2006). Because bean varieties consumed as a vegetable, produce pods in as little as two months, rotation with other crops is a common practice Broughton et al 2003). Whether a farmer plants one or two bean crop per year is determined largely by rainfall patterns. In tropical regions with single rainy season, only one crop is planted (Beebe et al, 2014) of 150000 to 400000 seeds per hectare. When intercropped, beans are sown at a lower rate (Wortmann, 2006). Bush-type varieties (hills 30-20cm apart, 3-6 plant per hill). Even within the type, planting densities vary widely, depending on local practice and degree of mechanization (Liebenberg, 2009; Wortmann, 2006). However, increasing the planting density generally increase yields (Russo and Perkins - Veazie).

II. MATEEIALS AND METHOD

1.Site Description

The experiment was conducted in Mendankwe a village located in Bamenda 1 subdivision North West Region of Cameroon. Mendankwelies North of Bamenda the capital City of North West Region.It has a population of about 17722 inhabitants (Statistic office North West Region; November 2016). The geographical coordinates of Mendankweare: Longitude 10, 14597000 and Latitude5.9597000. The principal activity of the inhabitants is agriculture: chief crops grown include beans, maize, potatoes and vegetables. This research was conducted from February 21 to June 30th 2019.The Bean seeds were purchased from farmershouse situated at hospital roundabout in the NorthWest Region of Cameroon. the beans were treated by disinfecting with a powder fungicide (Spectracidelmmunox) to protect the grains against pathogens such as mildew. The main materials that were used for the experiment are presented in Table I and II below:

Table 1: Materials used for the Experiment

MATERIAL	**ACTIVITY**
Cutlasses	It was used for clearing of the experimental plot cutting and preparing of pegs.
Rake	Use to rake the experimental plot and leveling of the experimental units
Hoe	Was used for tilling of the plot, formation of ridges, weeding and mulching
Pegs	To demarcate the experimental units and alignment of the plot
A tape of 50m long A graduated ruler	The tape was used for measuring the various dimensions of the experimental plot, the length of ridges, width and paths Use to measure plant height, leaf area index
Boots	Protective wears
Jumpsuit	To protect the body while working on the plot and also to avoid the spread of disease from elsewhere to the farm

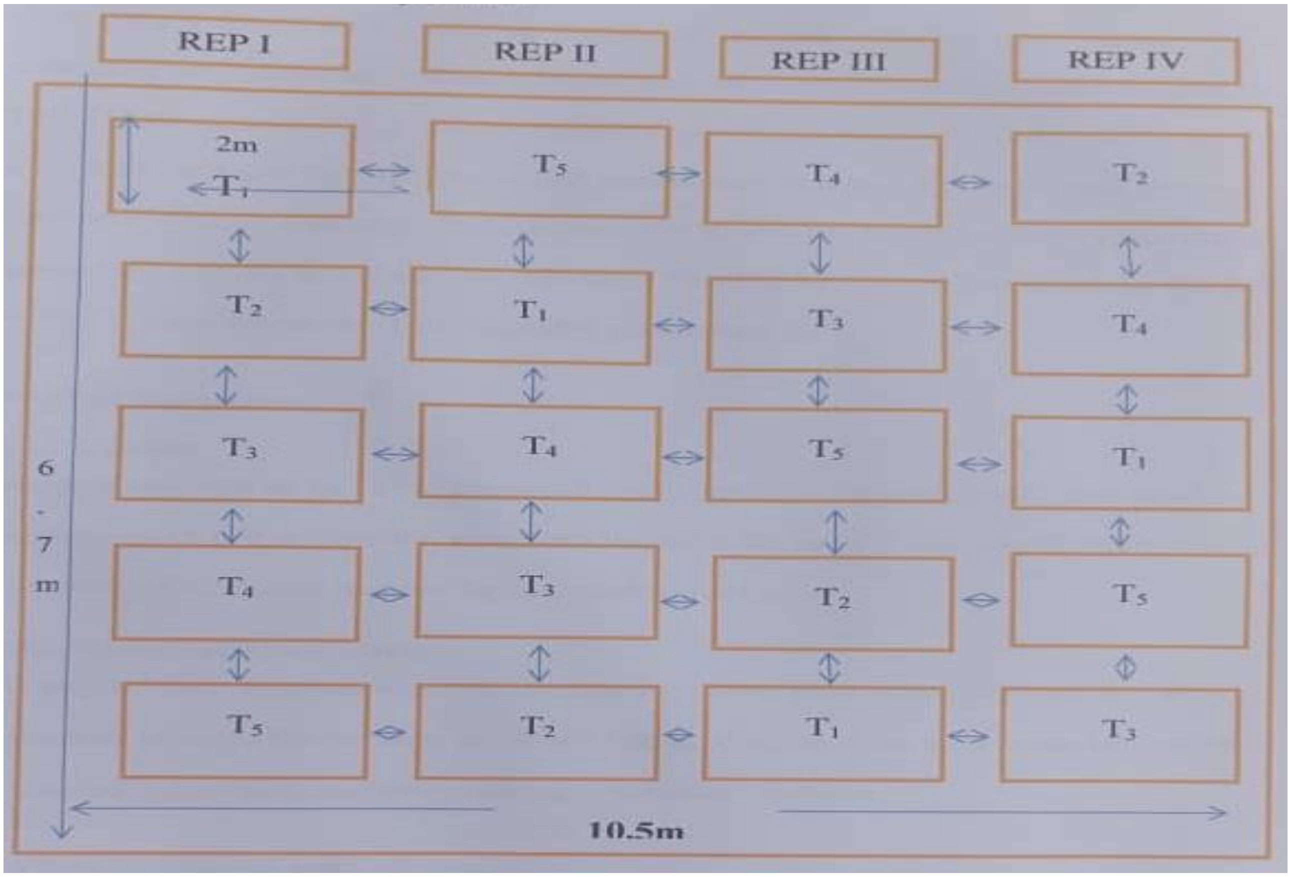
Table II: Treatments and Plant Spacing used in the Experiment

Treatment (T)	Spacing between plants (cm)
T1	10x75
T2	15x75
T3	20x75
T4	25x75
T5	30x75

2. Experimental Design and Description.

The experiment was arranged in a randomized complete block design with four replications Each replication consists of five ridges that received the five treatments. Each ridge or experimental unit measured 2m by 0.75m given an experimental area of 1.5m². Each of these treatments was replicated four times as presented in figure 1 below.

Fig 1: Field Layout of the Experiment.



3.Land Preparation

The experimental area was cleared using a cutlass. The grass was then raked to the border of the experimental area where it was pilled. The stock of grass and shrubs were off-rooted using a hoe and a dig axe. The soil was ploughed with a hoe, and exposed stones were picked and gathering at the border of the plot. Using a line, the portion was demarcated and the ridges pegged out. The ridges were then constructed along the lines.There were 4 blocks each containing 5 raised ridge. Each ridge had beans planted with a particular plant distance one treatment. Beans seeds were selected manually and planted on the 21 of February 2019 after 3 consecutive heavy rainfalls. Even though rainfall was limited for some days but due to high moisture content the seedlings withstand the short drought period. No manure or fertilizer application because beans is a legume and has root nodules which convert atmospheric nitrogen to soil nitrogen. The beans were planted two per hole 3cm deep, and later thinned to one plant per hole two weeks after germination.

4. Field Management.

Weeding was done on the 13th of March 2019 using hands by off-rooting early germinated weed seedlings and a hoe to cover the weeds with the soil at the paths. It was done in order to reduce competition for nutrients between the bean seedlings and grass. No major disease infection was noticed in the farm apart from some black ants and slugs that happen to cut down the succulent stems and cutting of leaves at the early stages but was easily controlled by hand picking, heavy watering as sanitation practices

5.Data Description and Collection.

The number of plants that emergence 8 days after planting was recorded by counts and entered per treatment.Plant height was recorded 69 days after planting. It was measured from ground level to the apex of the least developed leave using a meter ruler. The average of the five plants was calculated and recorded as the height of the treatment. 5 plants were randomly sampled per replicate and 3 leaves, starting from the based, middle and the apex. Leaves were measured using a ruler as length multiply by the width (LxB) 0.75 Joe 2000.Plant vigour was estimated using a scale of 1,3, and 5. A sample of 5 plants were randomly selected was used as presented in Table III.

Table III: Plant Vigour Scale

Scale		Description
1	Poor	Thin plants, stunted with poor vigor
3	Average	Average vigor plants
5	Good	Very Vigour, healthy plants

Plant earliness was done through observation of pods ripening per replication compared to emergence to find out the number of days taken by the plants for maturity.Flowering of the plants were recorded 30 days after planting, by the appearance of white, pink and purple coloured flowers at the nodes of leaves per replica. This stage revealed that, the plant has fully matured and has began reproduction. It was b-done by counting and entered per treatment.Five plants were randomly sampled per replicate and the number of pods counted. The average of the five plants was calculated and recorded as the number of pods per treatment.Five plants were randomly sampled per replicate, and three pods selected from the base, noddle and the apex of the plant. They were measured using a graduated roller in centimetres. The average length of the three pods was calculated and recorded as length of pods per treatment.Three pods were randomly selected from three plants per replicate. A pod from the base, middle and apex of the plant were threshed. The average number of seeds of the plant were calculated and recorded as number of seeds per pod.The number of grains per replicate were summed to make the total weight of seeds per treatment by weighing using a scale balance.The total number of pods per replicate at harvest was threshed and the number of grains counted and recorded as the total number of grains per treatment.

Harvesting was done in May 27/2019. The plants were carefully uprooted as to avoid scattering of pods. The pods were carefully threshold to separate the grains from the stalk per each treatment for data collection.Data collections were subjected to analysis of variance (ANOVA) to separate the treatments.

Treatment means were separated at p=0.05 using thee least significance used to bring out tables and bar charts.Results are presented in the form of tables and bar charts.

III.RESULTS AND DISCUSSION

RESULTS

1 Emergence of Bean Plants

The mean number of plants emerged were different. The percentage number of the plants that emerged ranged from 82% in treatment 5 (30cm spacing) to 98% in treatment 1(10cm spacing) with an average mean percentage of germination of 94.95%. The analysis of variance (ANOVA) revealed a significant difference p-0.05 among the rest of the treatments. The highest mean percentage number of plants emergence was recorded in treatment 1(10cm spacing). (Fig. 2).

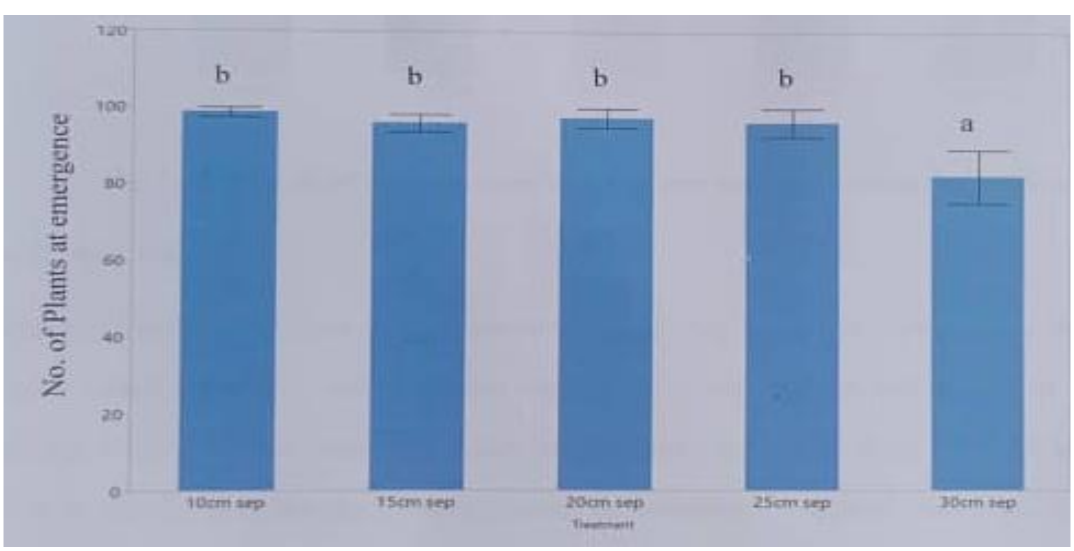


Fig 2: Emergence of Bean Plants as influenced by intra-row spacing in bean production.

In this study, mean plant heights were significantly influenced by intra row spacing. The mean plant height ranged from 23.3cm in treatment 5 (30cm spacing) to 28.3cm in treatment 2 (15cm spacing) with an overall mean of 25.705cm. The analysis of variance (ANOVA) shows that there
were significant difference (P=0.05) between the treatments. Treatment 2 (15cm spacing) had the highest mean plant height (Fig. 3).

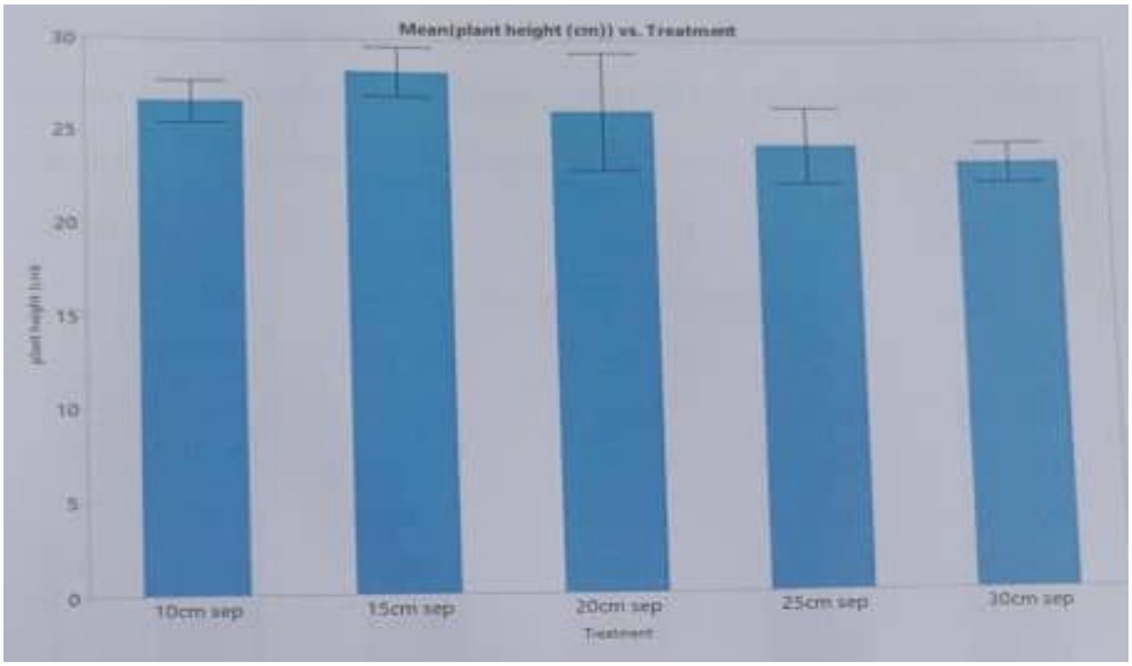


Fig 3; Plant Height as influenced by intra-row spacing in bean production

Mean plant vigour as influence by intra-row spacing in this study was different. The mean plant vigour varied from 3.25 with inter-row spacing of 10cm and treatment3 with an intre-raw spacing of 20cm to 5 in treatment 4 with the intre-row spacing of 25cm. The chi square test revealed significant difference (P=0.05) among the treatments. The best mean plant vigour was recorded in treatment 3 (20cm spacing) and treatment 4 (25cm spacing). (Fig. 4).

Oneway Anova

Summary of Fit

Rsquare	0.623921
Adj Rsquare	0.523633
Root Mean Square Error	1.008299
Mean of Response	7.85
Observations (or Sum Wgts)	20

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Treatment	4	25.300000	6.32500	6.2213	0.0037*
Error	15	15.250000	1.01667		
C. Total	19	40.550000			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
10cm sep	4	6.25000	0.50415	5.1754	7.325
15cm sep	4	7.50000	0.50415	6.4254	8.575
20cm sep	4	9.00000	0.50415	7.9254	10.075
25cm sep	4	9.25000	0.50415	8.1754	10.325
30cm sep	4	7.25000	0.50415	6.1754	8.325

Std Error uses a pooled estimate of error variance

Fig 4: Plant Vigour as influenced by intra-row spacing in bean production.

Mean plant vigour as influenced by intra-row spacing in this study was different. The mean plant vigour ranged from 25% in treatment 1 (10cm spacing) to 75% in treatment 4 (25cm spacing) with an overall mean of 50%. The Chi-square test revealed significant difference (P=0.05) among the treatment. The best mean plant vigour was recorded in treatment 3 (16cm spacing) and treatment 4 (25cm spacing)

The average number of days from planting to flowering of beans as influenced by intra-raw spacing was different among treatments. The average number of days at ripening from planting ranged from 36 days in treatment of variance (ANOVA) p=0.05 revealed a significant difference between treatment Treatment 1(10cm spacing) recorded the lowest number of days for flowering.(Fig. 5).

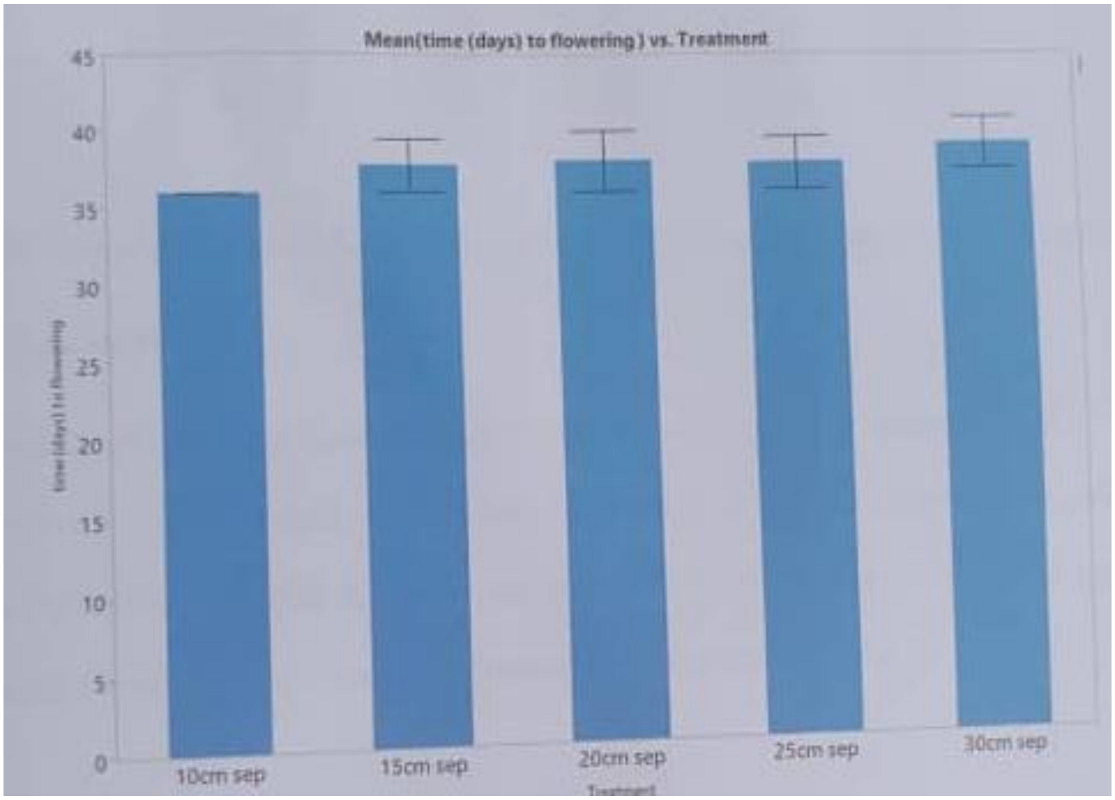


Fig 5: Flowering as influenced by intra-row spacing in bean production.

2. Leaf Area Index (LA1)

The leaf area index like many other morphological parameters was significantly at (P=(0.7335) influenced by bean plant density. The leaf area index ranged from 22.6cm² in treatment 5 (30cm spacing) to 37cm² in treatment 4(25cm spacing). The best leaf area index is observed in treatment 4(25cm spacing).(Fig. 6).

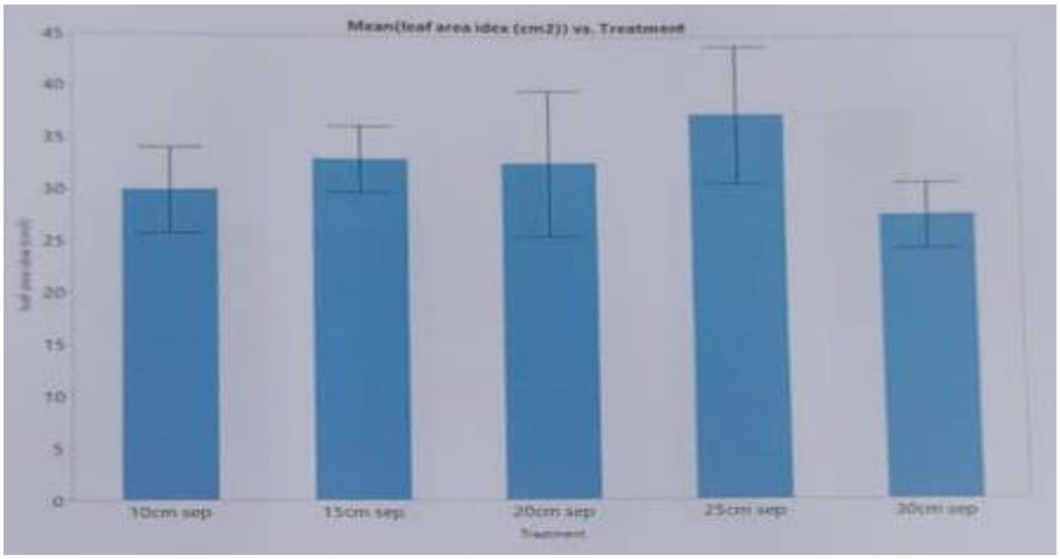


Fig 6: Leaf Area Index (LAI) as influenced by intra-row spacing in bean production in Mendankwe.

4.Plant Earliness

The mean number of days from planting to, ripening of beans pods ranged from 69.75 days in treatment 1 (10 cm spacing) to 77.5 days in treatment 4 (25 cm spacing). The analysis of variance (ANOVA) revealed that there were significant difference (P=0.05) between treatments.Earliness of bean pods was observed in treatment 1(10cm spacing). (Fig. 7).

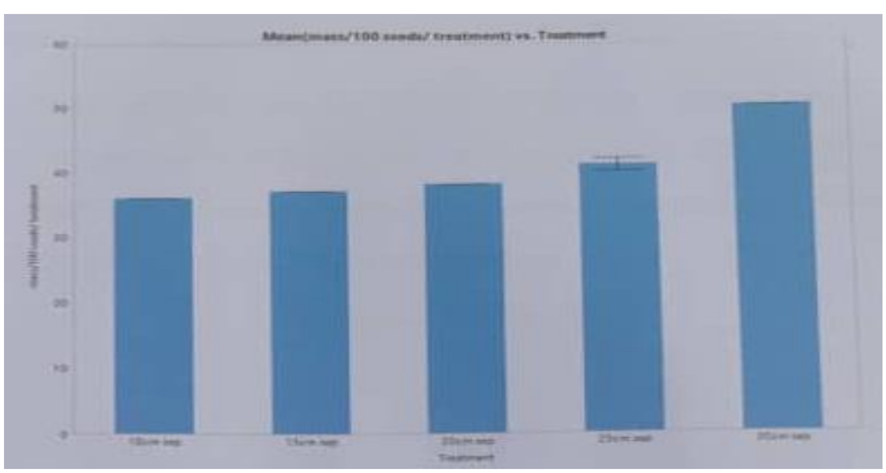


Fig 7: Plant Earliness as influence by intra-row spacing bean production.

5. Number of plants at Harvest.

The mean number of plants at harvest from the total number at planting per treatment ranged from 14 plants in treatment 5(30cm spacing) analysis of variance (ANOVA) P=0.05) revealed that there were significant difference between. The highest number of plant at harvest was recorded in treatment 1(10cm spacing) (Fig. 8).

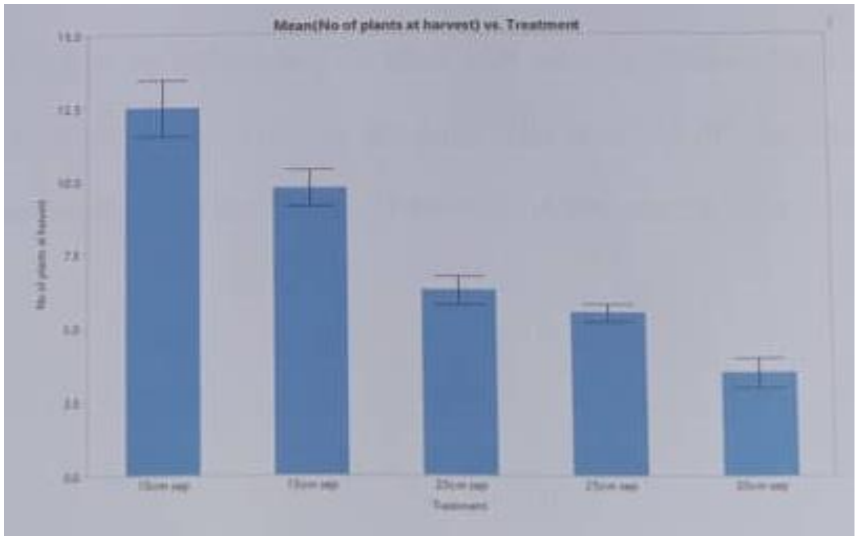


Fig 8: Number of plants at Harvest as influenced by intra-row spacing

6. Number of Pods per Treatment

The mean number of pods as influenced by intra-row spacing ranged from 25 pods in treatment 1(10 cm spacing) to 37 pods in treatment 4 (25cm spacing). The analysis of variance (ANOVA) revealed that there were significant different P=0.05 between treatments. The highest number of pods was recorded in treatment 4(25cm spacing). (Fig. 9).

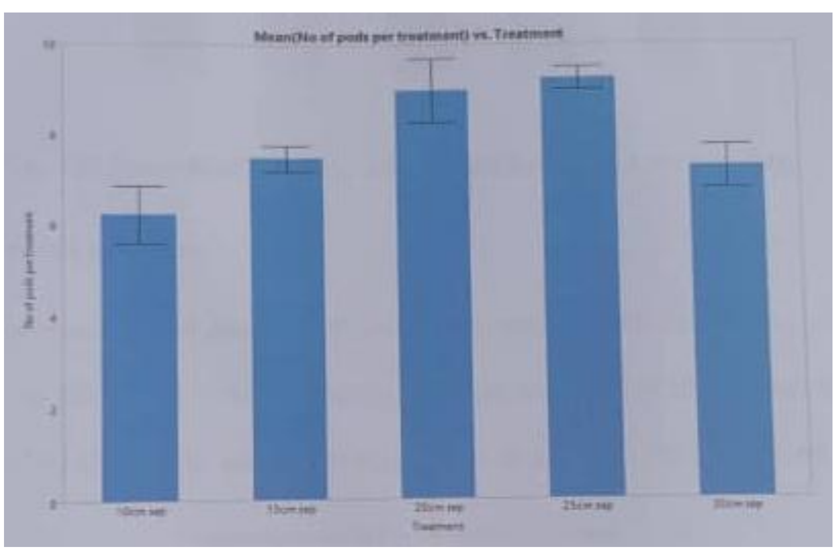


Fig 9: Number of Pods per Treatment Harvest as influenced by intra-row spacing

7. Length of Pods

The mean length of pods as influenced by intra row spacing ranged from treatment 1(10 cm spacing) to 10.5 cm in treatment 4 (25cm spacing). The analysis of variance (ANOVA) shows that there were significant difference (P=0.05) among the treatments. (Fig. 10).

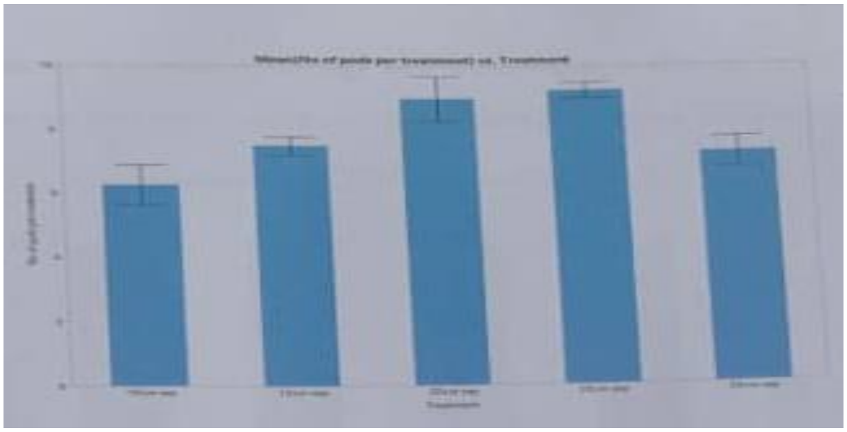


Fig 10: Length of Pods as influenced by intra-row spacing.

8. Number of seeds per pod.

In the study, the average mean number of seeds per pods as influenced by intra-row spacing ranging from 3.25 in treatment 5(30cm spacing) to 5 in treatment 3(20cm spacing). The analysis of variance (ANOVA) show that there were significant different (P=0.05) among the treatment.

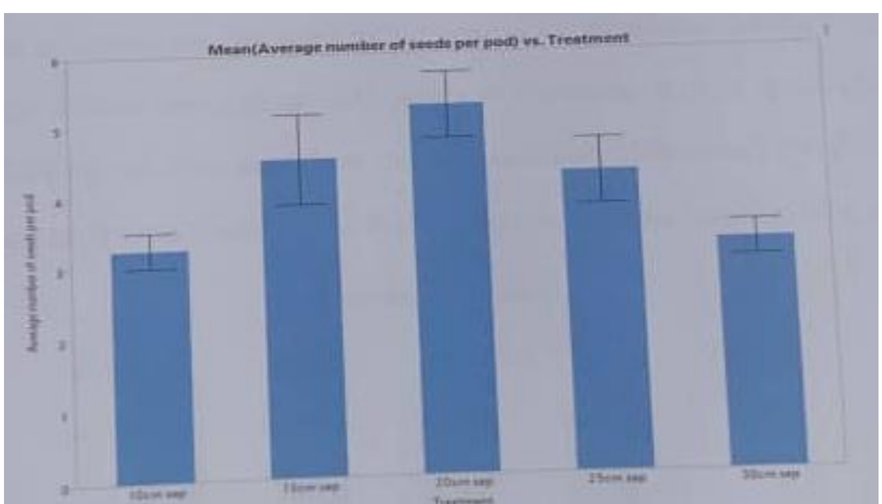


Fig 11: The mean number of seeds per pod as influenced by intra-row spacing.

9. The Mean Weight of Seeds per Treatments

The mean weight of seed per treatments as influenced by intra-row spacing were not different among treatments. The mean weight of 0.5kg in treatment 1 (10cm spacing) and treatment 2.(15cm spacing) treatment 3 (20cm spacing) and treatment 4 (25cm spacing). The analysis of variance (ANOVA) shows that there were no significant difference between treatments.(Fig. 12).

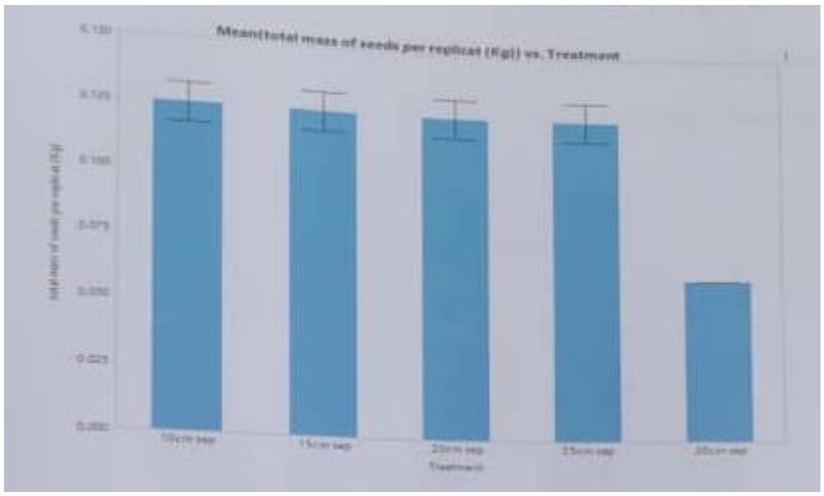


Fig 12: The mean weight of seeds per treatments

10. Number of Grains per Treatment.

The mean number of grains per treatment as influenced by intra-row spacing ranged from 414 grains in treatment 5(30cm spacing) to 1283 grains in treatment 2(15cm spacing). The analysis of variance (ANOVA) revealed that there were significant difference (P-0.05) between the treatments. Treatment 2(15cm spacing) had the highest mean grains number. (Fig. 13).

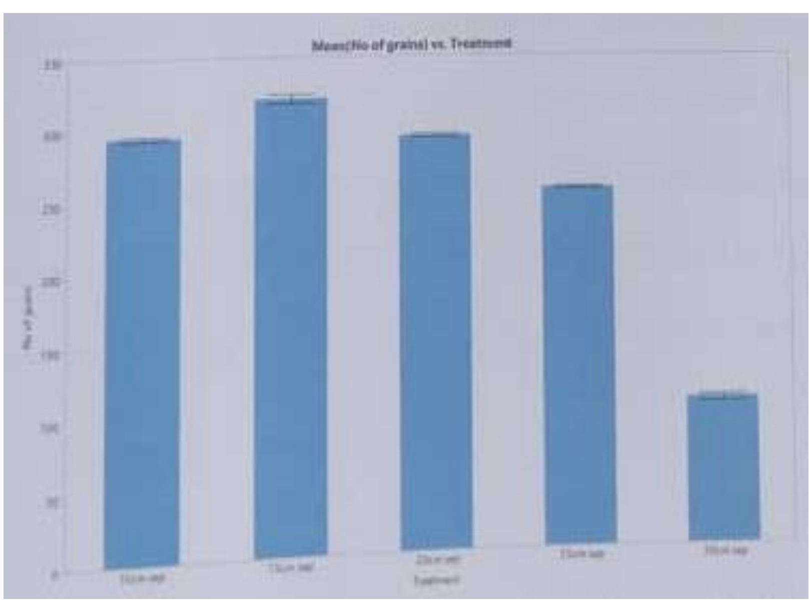


Fig 13: The mean number of grains per treatment as influenced by intra-row spacing.

11. Weight of 100 grains.

In this study, the mean weight of 100 grains per treatment measured using an electronic scale as influence by intra-row spacing, ranged from 36.07 grains in treatment 1(10cm spacing) to 50.24 grains in treatment 5 (30cm spacing). The analysis of variance (ANOVA) shows that there was a significant difference (p=0.05) among treatments. (Fig. 14).

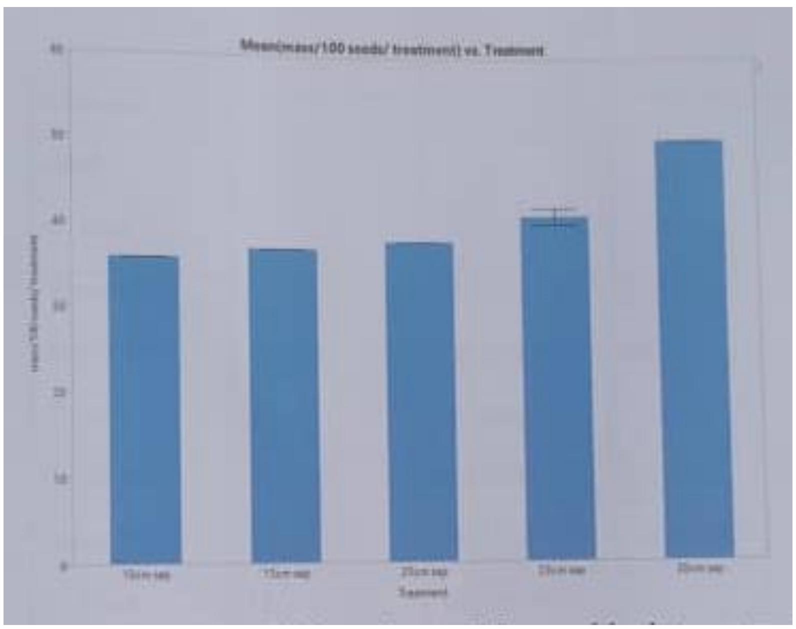


Fig 14: The mean weight of 100 grains as influenced by intra-row spacing.

12. Analysis of Variance (ANOVA)

Table 4 shows the analysis of variance for the agronomic and yield parameters in this study. The blocking effect did not significantly (p=0.05) influenced any measured parameter in this study.

Table 4: ANOVA Analysis for Beans Morpho-physiological and Yield Parameters

Thus the blocking effect was omitted in the ANOVA analysis in order to increase the error degree of freedom (df). Consequently, increasing the reliability of the analysis by increasing the error effect. The effect of beans row spacing was not significant at (P=0.0531) for all agronomic parameter except for flowering (p=0.7742) leaf area index (p=0.7335) and plant vigour (chis square -0.7084).

Discussion

The number of plants that emerged was different. The difference in emergence might have been due to the viability of the bean seeds or other environmental factors such as soil structure. Viability of seeds is a genetical factor in seeds, since the source of seeds and preservation was not known. This study was in line with Tange Denis Achirt (2017) who obtained the same result in the study of influence of maize density on morpho-physiological and yield parameters in Bali.Plant height was highest at 15cm spacing. At this spacing there is high competition for sunlight, plant elongation usually occur at high population densities. This might have been the case of this result. Leibenberg (2016) found that plant height was influenced by density. Plant height increased with increase in plant density.Plant vigour was highest in the 20cm spacing. At this spacing there was low competition for soil nutrients, sunlight, soil, structure and appropriate feeding zone. This might have been due

Parameters	Source	Degree of freedom(df)	Sum of Squares	Means Square	F Radio	Prob>F
Plant Emergence	Treatments Error C Total	4 15 19	727.3000 911.2500 16385500	181.825 60.750	2.9930	
Plant Height	Treatments Error C Total					
Flowering	Treatments Error C Total	4 15 19	18.70000 157.50000 176.20000	4.6750 10.5000	0.4452	0.7742
Leaf area Index (LAI)	Treatments Error C Total	4 15 19	216.6940 1612.2165 1828.95000	54.173 107.481	0.5040	0.7335
earliness	Treatments Error C Total	4 15 19	136.7000 316.25000 452.95000	34.1750 21.0833	1.6209	0.2206
Number of plants at Harvest	Treatments Error C Total	4 15 19	206.50000 22.50000 229.00000	51.6250 1.5000	34.4167	<.0001*
Number of pods	Treatments Error C Total	4 15 19	25.300000 15.250000 40.550000	6.32500 1.01667	6.2213	0.0037*
Length od pods	Treatments	4 15 19	11.800000 12.000000 28.80000	2.95000 0.80000	3.6875	0.0278*
Number of seeds per pods	Treatments Error C Total	4 15 19	0.01237550 0.00275225 0.01512775	0.003094 0.000183	16.8619	<.0001*
Weight of seeds per treatement	Treatments Error C Total	4 15 19	52646523 12.000000 538.46523	131.616 0.800	164.5204	<.0001*
Mass per 100 seeds	Treatments Error C Total	4 15 19	526.46523 12.00000 538.46523	131.616 0.800	164.5204	<.0001*
Total number of grans per treatement	Treatments Error C Total	4 15 19	121138.50 258.50 121397.00	30284.6 17.2	1757.328	<.0001*

to maximum utilization of soil fertility and environment factors. Plant vigour measures the visual appraisal of the toughness and thickness of the plant Ashraf (2009).Early flowering of plants was observed in 10cm spacing. This might have been due to high population densities with high interaction and concentration of nodules and micro organisms as well as genotype and environment. The study was in linewith the result of Msbhakta, 2017 who observed that early flowering of plants occur in high plant densities.The leaf area index was highest in 20cm spacing. In our study leaf area index was calculated based on the length and the width. Our result is similar to that recorded by Telio-Kagho and Gardener, 1987 in their study of response of maize to plant population density.Plant earliness were different per treatments. Earliness in plant ripening was noticed in 10cm spacing. The early senescence observed from high density plants can be explained by the high stress in the plant, such as competition for nutrients, light, water and space (Boomsma, 2002).This stress or decrease the overall physiology of the plants leading to earliness.The number of plants at harvest were different per treatment due to differences in spacing and environmental factors such as pest and insects attacks.Here were many pods in high density stands, that did not translate into higher widths of seeds.Our result is in line with that of Adeniyam, (2014). Zamir et al., (2011) posited that Competition inhigh plant density stands reduces the supply of nitrogen, photosynthesis and water to the growing pods. It is also retorted that as plant density increases, general weight is more stable than other yield parameters. Westgate, (1997).The weight of seeds per treatment were different. The highest weight of seeds were in the planting spacing of 10cm, 15cm, 20cm and 25cm. this might have been due to increase in temperature and water availability and also plant population densities.

Conclusion

The main objective of the study was to evaluate the effect of morpho-physiological and yield parameters as influenced by intra-row spacing of beans in Mendankwe. The yield of beans was greatly influenced by the intra-row spacing of beans of 25cm which had the greatest influenced on yield.The morpho-physiological parameters were more influenced by intra-row spacing. Treatment 4 had the best results with intra-row spacing of 25cm by 0.75m.From the study, it is recommended that farmers in Mendankwe and its environs, should use plant spacing of 25cm between plants by 0.75m ridge to produce their beans.Further research should be done on the soil fertility of Mendankwe

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