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# Effect of Planting Dates on Growth and Yield of Common Bean (*Phaseolus vulgaris)* Under Varying Plant Population in Highlands of Central Kenya

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## Abstract
Studies have shown that increasing dry bean production in many rural agricultural centers in Africa is a problem. In an effort of overcoming this limiting problem, economic use of land by increasing seed rate during planting time per unit area has become common. Efforts of realizing high yields by increasing seed rate per unit area seemed not to bear much fruit due to lack of knowledge on timely planting and plant population. Three different areas in central Kenya were evaluated for the relationship between timely planting dates and plant population in dry bean production. The study aimed at evaluating the effect of dry bean production, in response to planting dates and plant population in *Chelelang* variety of dry bean (*Phaseolus vulgaris*). The study took note on the following growth parameters; the number of pods per plant, pods length, number of seed per pod and grain yield. Each plot layout measured 4x4 m. There were 9 plots in each of the 3 blocks. A path of about 1m was left between blocks. Each plot received treatment combinations assigned randomly. Using Randomized Complete Block Design (RCBD) the experiment was replicated three times. Factors were three planting dates 10th March, 20th April and 5th May and three plant densities; 1 seed / hill, 2 seeds / hill and 3 seeds/ hill. All the trials received similar field management treatments. Data was collected, organized, and analyzed by use of SPSS (Version 22) and the means separated by use of Least Significant Difference (LSD).The study results indicate that planting date and the plant population are significant on length of the pods, number of pods and final grain yield but no significance influence in seed numbers per pod. The study recommend that farmers should observe planting dates and proper plant population as a way of obtaining good harvest in common bean (*phaseolus vulgaris)*

Key words planting dates, common bean, plant population

## 1 Introduction
Dry bean varieties originated in America. Only five species; *Phaseolus acurifolius, Phaseolus coccineus L, Phaseolus Lunatus L, Phaseolus polyanthus Greenman and Phaseolus vulgaris L.* were domesticated (Beaver et al., 2002). Other smaller interspecies were later grouped into primary, secondary, tertiary gene pool. The interspecies diversity was further categorized into Andean and Middle American major gene pools. In addition cultivar of dry bean and snap bean existed. (Villanueva, Sibirya & Hannah, 2002).

## 2 Crop establishments
common bean average yield has increased in the new millennium due to regular research findings, however this has had an irregular production rate due to variation in a biotic factor (Bourgaunt et al., 2007). One of the significant factors of irregular production is climate change (Jettner et al., 1999). Planting dates is one of the most important factors of dry bean growth and tield (Fagnamo et al., 2009). Lack of adequate moisture during flowering and seed filling stage affect the number of pods, pod length and the final yield (Taostat at al., 2008).Field management and appropriate planting dates determine the seed weight and vegetative growth (Schwarteet al., 2005). Spatial arrangement during planting of common beans has a significant effect on seed numbers per pod (Esmaeilzadeh & aminpanah, 2015). Crop planting pattern, planting dates and competitiveness of mineral element in soil affect overall dry bean vegetative growth and final grain yields (Buruchara at al., 2000).Early

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planting enhances crop competitive to weed, utilize available moisture solar radiation which finally increase seed yield (Pynenburgat al., 2011).

## 3 MATERIALS AND METHODS

### 3.1 Climatology

The study area has daily temperatures ranges between 10 to 25 $^0$C; it lies between 2100 m and 3000 m above sea level. The rainfall varies with altitude, and ranges between 700 mm - 1500 mm. Its pattern is bi- modal and characterized by heavy showers and storms that sometimes cause severe erosion and considerable crop damage. The area has two rainy seasons, the March to May long rains and October to December short rains (Mutuma, 2002).

### 3.2 Soils

Before sowing, composite soil of depth of about 0-20 cm was drawn from experimental plot and was taken for analysis at Kenya Agricultural Research institute (KARI). According to the KARI report the site had a red volcanic loam soil of pH 6.8, with deep, well drained fertile soils.

### 3.3 Experimental Procedures

Land preparation was done on February. The study was carried out during the month of March to August. The experiment was treated with three planting dates 10$^{th}$ March, 20$^{th}$ of April and 5$^{th}$ of May 2014. Plots of 4x4m were demarcated with paths of one meter in between plots and replication. Dry bean seeds were planted directly to the soil with the spacing of 30x30 cm. All plots received equal fertilizer treatments of 50 kg/ha DAP at planting. The experiment involved 27 plots; each measuring 4x4 m. Plots received 3 different plant densities with different planting dates. The experimental plots were arranged in Randomized Complete Block Design (RCBD).It was replicated three times

### 3.4 Treatments and Treatment Combinations

**Treatments**

**(i)Planting dates**

(a) 10$^{th}$ March
(b) 20$^{th}$ April
(c) 5$^{th}$ May

**(ii)Plant Densities**

(a) (1 seeds per hill) **D1**
(b) (2 seeds per hill) **D2**
(c) (3 seeds per hill) **D3**

### 3.5 Plot Layout

Each plot measured 4x4 m. There were 9 plots in each of the 3 blocks. Plots received three replications as follow,

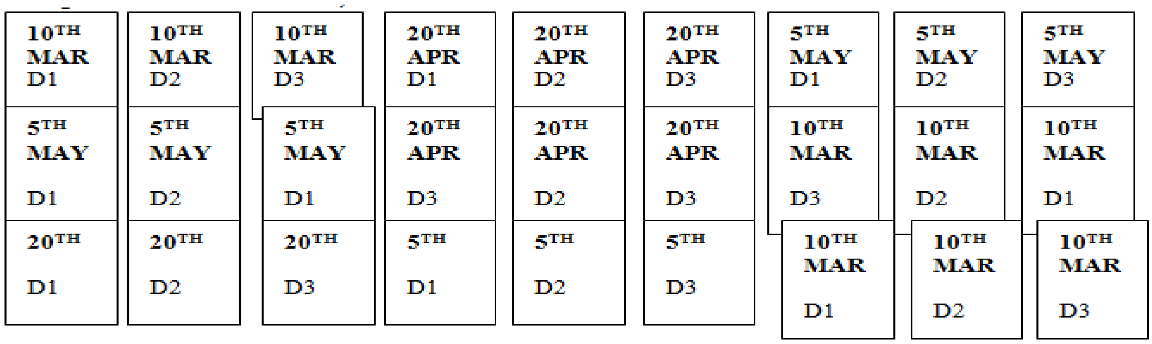


Figure 1 Plot Layout

# 4 RESULTS AND DISCUSSIONS

## 4.1 Number of Pods

Number of pods was recorded after 30 days from the date of planting up to harvest. Figure 1 shows the results. The analysis of variance (ANOVA) indicated that there were significant difference ($P<0.05$) in the number of pods between the three planting date and three plant densities. Regardless of plant population the number of pod decreased by 21% as the planting dates moved from 10$^{th}$ March to 5$^{th}$ May. Beans plant pod numbers were most sensitive to a period of dry spell as a result of late planting. General appearances of the number of pods were not only reduced in length but also in thickness. An increase in density appeared to have advance effect on the number of pods. Pods' numbers appeared to be more with decrease in population. Pod number with 2 seeds/hill **(D2)** showed a relatively higher average number of pods than 3 seed/ hill **(D3)** but slightly lower than 1 seed/hill **(D1)**. The size of pods was slightly thicker in lower plant population than higher population and seemed to contain more seeds in the pods. Thickness of the straw in lower density planting sustained the number of pods and a few stands without pods were realized than high density planting

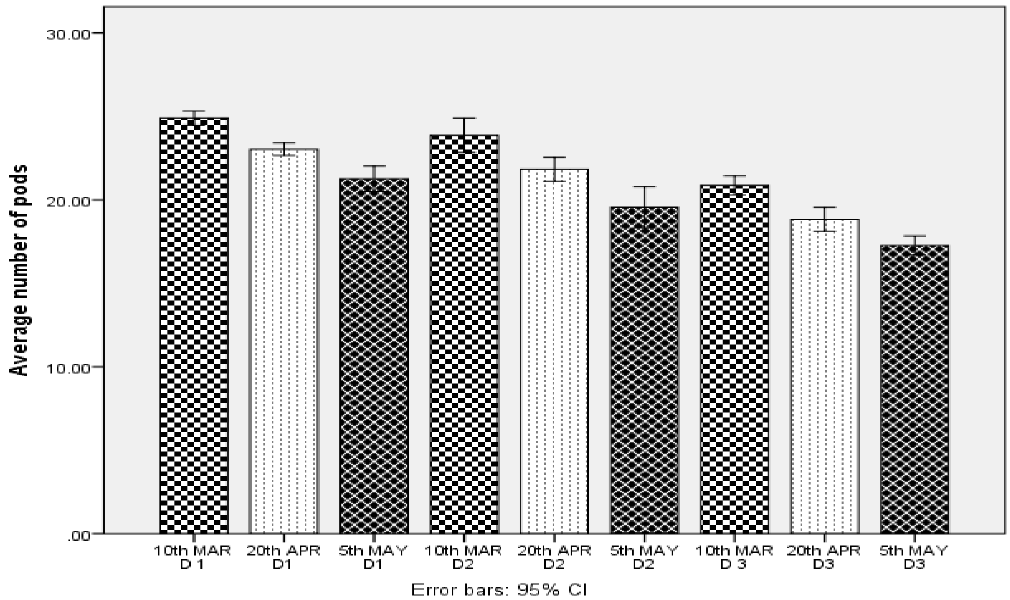


Figure 1 Effect of planting dates and plant population on number of pods

### 4.2 Pod Length

The length of pods was measured at 32th day of germination.. The results are shown in the figure 2. The analysis of variance (ANOVA) indicated that there were significant differences (P<0.05) between the pod length of the three planting dates.Pod length significant difference was recorded lowest in seed planted on 5$^{th}$ May. Planting dates X plant density had significant interaction on length of pods. Highest pod length was recorded highest in lower plant population and early planting dates.

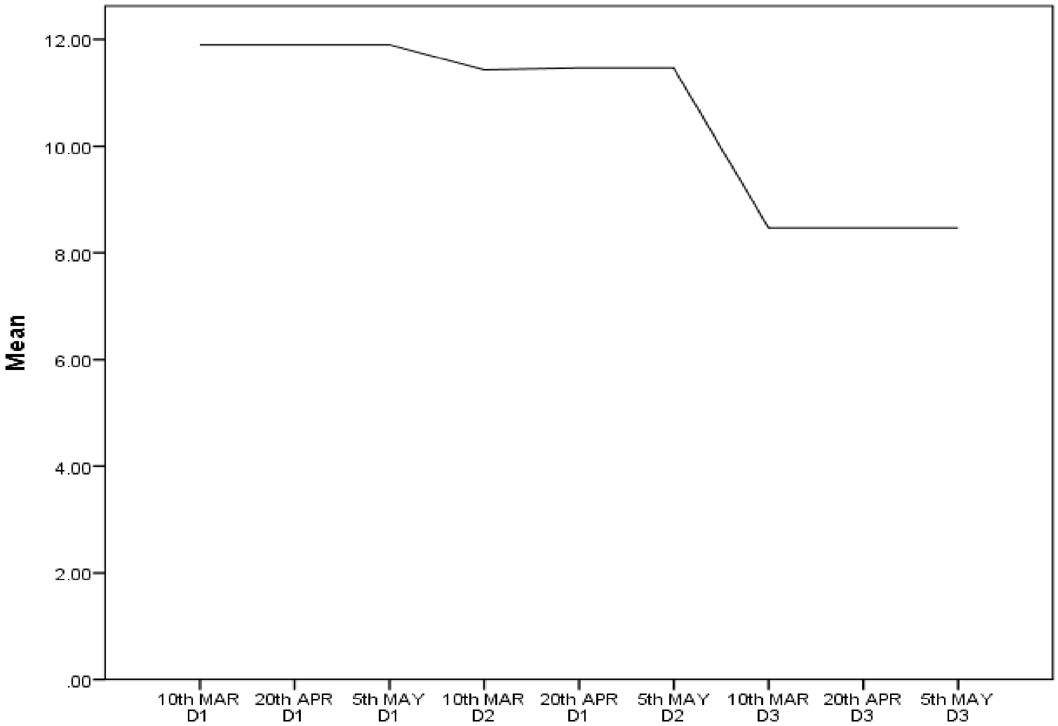


Figure 2 Effect of planting dates and plant population on pod's length

### 4.3 Seed Number per Pod

Seed numbers per pod were not significantly influenced by planting dates. The only significant difference was their sizes, where by late planting had small sized seed but equal number of seeds as in case of early planting. Low density planting (1 seed/hill) did not show significant difference in the seed numbers per pod across all planting dates. However, seed sizes and seed filling were higher than high density planting. High density planting (3 seeds/hill) increased completion among various mineral elements and moisture in the soil coursing stand mortality (stand without pods) hence decrease in pod numbers but had no significant difference in seed numbers per pods across all planting dates. This was contrary to the finding of Esmaeilzadeh et al. (2015) who found that seed numbers per pod were significantly influenced by spatial arrangements.

Table 3. Effect of planting dates and plant population on seed numbers per pod

| P. Date/Density | 10th MAR D1 | 20th APR D1 | 5th MAY D1 | 10th MAR D2 | 20th APR D2 | 5th MAY D2 | 10th MAR D3 | 20th APR D3 | 5th MAY D3 |
|---|---|---|---|---|---|---|---|---|---|
| 10th MAR D1 | ////////// | -0.03* | -0.03* | - 0.029* | - 0.029* | -0.03* | -0.03* | 0.029 | -0.03* |
| 20th APR D1 | -0.03* | ///////// | -0.03* | 0.03* | -0.029 | -0.029 | -0.03* | -0.03* | -0.03* |
| 5th MAY D1 | 0.03* | 0.03* | //////// | - 0.029* | -0.03* | -0.03* | -0.03* | - 0.029* | -0.03* |
| 10th MAR D2 | 0.029* | 0.03* | 0.029* | /////// | -0.03* | -0.03* | - 0.029* | - 0.029* | -0.03* |
| 20th APR D2 | 0.029* | -0.03* | 0.029* | -0.03* | //////// | -0.029 | -0.029 | -0.03* | -0.03* |
| 5th MAY D2 | 0.03* | -0.03* | 0.029* | 0.03* | 0.029 | ////////// | -0.03* | -0.03* | -0.03* |
| 10th MAR D3 | 0.03* | 0.03* | 0.029* | 0.03* | 0.029 | 0.03* | ////// | -0.03* | -0.03* |
| 20th APR D3 | 0.029 | -0.03* | 0.029* | 0.03* | 0.03* | 0.03* | 0.03* | ////// | -0.029* |
| 5th MAY D3 | 0.03* | 0.03* | 0.029* | 0.03* | 0.03* | 0.03* | 0.03* | 0.029* | //////// |

*The mean difference is significant at the 0.05 level

### 4.4 Grain Yield

On the day of harvesting dry beans were separated from their pods. They were weighed using an electronic weighing scale and their mass tabulated. Table 4 below shows the results

Table 4. Effect of planting dates and plant population on grain yield

| P. date/Density | 10th MAR D1 | 20th APR D1 | 5th MAY D1 | 10th MAR D2 | 20th APR D2 | 5th MAY D2 | 10th MAR D3 | 20th APR D3 | 5th MAY D3 |
|---|---|---|---|---|---|---|---|---|---|
| 10th MAR D1 | ////////// | -1.73* | -3.5* | -0.6* | -2.6* | -4.57* | -1.93* | -3.66* | -5.36* |
| 20th APR D1 | 1.73* | ///////// | - 1.77* | -1.13* | -0.87* | -2.84* | -0.2* | -1.93* | -3.63* |
| 5th MAY D1 | 3.5* | 1.77* | //////// | 2.9* | 1.9* | 0.07* | -2.57* | -.084* | -0.86* |
| 10th MAR D2 | 0.6* | 1.13* | 2.9* | /////// | -2* | -3.97* | 1.33* | -3.06* | -4.76* |
| 20th APR D2 | 2.6* | 0.87* | 1.9* | 2* | //////// | -1.97* | -0.67* | -1.06* | -2.76* |
| 5th MAY D2 | 4.57* | 2.84* | 0.07* | 3.97* | 1.97* | ////////// | -2.64* | 0.91* | -0.79* |
| 10th MAR D3 | 1.93* | 0.2* | 2.57* | 1.33* | 0.67* | 2.64* | ////// | -1.73* | -4.43* |
| 20th APR D3 | 3.66* | 1.93* | -084* | 3.06* | 1.06* | 0.91* | 1.73* | ////// | -1.7* |
| 5th MAY D3 | 5.36* | -3.63* | 0.86* | 4.76* | 2.76* | 0.79* | 4.43* | 1.7* | //////// |

*The mean difference is significant at the 0.05 level

From the table above, the total grain yields per plot was different according various treatment combinations. Plant density x plating dates had a significant interaction effect on weight of seeds. High density planting and late planting reduced 100 seeds weight by 6.7% **D1** (One seed / hill) had the least grain yields per plot. This could be as a result on total production per plot had a few seeds that were planted, therefore contributed to lower production of grains per plot. Treatment combination with **D3** (Three seeds / hill) seemed to give more yields per plot but it is uneconomical since the initial plant does not give out the final product because of stand mortality in late planting. The optimum combination that gave relatively higher yields than the rest in term of economic of seeds planted and greater yields per plot is **D2**(two seeds / hill) combination, whereby early planting and optimum seed density was treated.

## 5 CONCLUSIONS

Planting date and the plant population are significant on length of the pods, number of pods and final grain yield but no significance influence in seed numbers per pod. Planting date on the onset of optimum moisture in the soil does not only provide early establishment of common bean but avoid period of dry spell during flowering stage that affect number of pods as well as final grain yield. Increases in plant density (3 seeds per hill) causes weakness in the length of the straw due to competition for the sunlight and as a result stands mortalities with no pods which later affect the final grain yields. Therefore, agronomical practices that can improve seed yields are of great importance. From the investigation, it is apparent that planting dates and proper plant population are recommended for obtaining good harvest in common bean (*phaseolus vulgaris)*

## References

Beaver, J.S., Godon, G., Caro Rosas, J., Steady man, J. (2002). Strategies for selecting common beans with a higher resistance to web- blight. *Agronomic mesoamencana.* 13: (1) 67-72

Begun A Ahad M. 0.kaisar M. M. Islam and M.k Anan (2003) Effect of sowing dates and fertilizer treatment on the reproductive variability on French bean Pakistan Journal of Biological science6 (22) 1897-1901

Bourg aunt M. C.A. Madramootoo HA Webber G. Smith (2007) Legume production and Irrigation strategies In a semi and environment. Option Mediterranean's 56223-234

Conditions.A Canadian journal of plant science 25(20)221-253

Esmaeilzadeh & aminpanah (2015) effects of planting date and spatial arrangement on common bean (*phaseolus vulgaris*) yield under weed-free and weedy

Hossain et al.(2003)Planting dates influence on dual purpose winter wheat forage yield grain and test weight .Agronomical journal of lant science.95(5),1179-1188

Jettner R.J Siddique K H.M lLoss S.P & French R.J ( 1999). Management in type II black bean.Weed technology 27 (3) 538-546

Malik V.S.et al(1993).Interaction of white bean (phaseolus vulgaris)cultivars, row spacing and seeding density with annual weeds. Journal of Weed science 41(1)62-68

Mashingaidze A.B et al (2009).Narrow row reduce biomas and seed production of weed and incrase maize yield.A journal of applied biology.155(2),207-218

Pynenburg,G M.(2011) The interaction of annual weed and white mold management system for dry bean production in Canada.Candian Journal of plant science.91(3),587-598

Schwarte,A.J (2005) Planting date effect on winter triticle dry matter and nitrogen accumulation.Agronomical journal of plant sicience.97(5),1333-1341

Vilanueva, M.A., Campos, F., Diaz, C; Colmenero- Flores, (2000). Actin expression in germinating seed of phaseolus vulgans L. *Planter.* 207: (4) 582-589