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Research Article

INFLUENCE OF SOWING DATES ON THE CULTIVATION OF SOYBEANS (*GLYXINE MAX* Merril) INKABINDA REGION, IN THE DEMOCRATIC REPUBLIC OF CONGO

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Abstract

Climate is the primary determinant of agricultural productivity and has a significant influence on food production and the economy of a developing country. The main factor limiting soybean cultivation in tropical countries is water. Two main agronomic innovations can increase soybean yield potential and/or reduce water requirements: selecting drought tolerant genotypes and offsetting sowing dates. The objective of this article is to assess the effects of sowing dates on soybean growth and production with a view to increasing its yield in Kabinda. The test was installed using a 3-repetition splot split device. The main plots consisted of planting dates (September 15, September 21, and September 28) at 40 cm x 40 compacting. The results of this study showed that late planting of a fortnight had an effect on soybean growth and yield. However, soybean yield increases significantly for a September 15 planting under Kabinda agro ecological conditions. In view of these results, an early sowing in the first half of September is recommended so that the soybean crop benefits from a maximum rainfall allowing to obtain an optimal production.

Keywords: Climate change, Agricultural productivity, Sowing dates, Soybean.

INTRODUCTION

In the Democratic Republic of the Congo, food production remains insufficient and the country relies on food imports. Food prices are rampant and under nutrition is a concern in some provinces. DR Congo stands out for its food deficit and this calamity is largely due to the level of lower yields obtained, and also to the use of traditional farming practices in peasant settings (SENASEM, 2008). Indeed, Congolese agriculture is predominantly peasant, requiring the use of more beneficial methods (Kasongo *et al.,* 2013).In addition, in DR Congo, the population is poor and does not have easy access to proteins of animal origin. To address malnutrition and under nutrition in developing countries where meat consumption remains a luxury, legumes like soybean, is a substantial palliative in terms of protein intake in food and feed in peasant environments (Mackinder *et al.,* 2001). Soybean is a legume crop that does not require nitrogen fertilization, with few phytosanitary treatments and provides high-protein seeds (with the average of 38-42% in dry matter). The main limiting factor for soybean production in tropical countries is water (Useni *et al.,* 2014).Water deficiency imposed during the seed filling period is particularly limiting the yield soybean. Two key technologies are identified that could increase soybean yield potential and/or reduce water and irrigation requirements: select drought tolerant genotypes and shift planting dates to avoid the dry period at the most sensitive stages of the development cycle (Ngoyi and Nkangu2021). Early seeding could also increase soybean productivity by lengthening the crop cycle. However, some literature shows that yield decreases significantly if sowing is late (Makungu, 2002; Nyabyenda, 2005; Yao-Kouamé *et al.,* 2012).

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Jaliya *et al.* (2008) evaluated the effects of 3 planting dates (June 10, 20, and 30) of maize (*Zea mays* L.) in Nigeria, with a low yield of maize planted on June 30. Similar results were obtained by Sadeghi and Niyaki (2013) by evaluating the effects of 4 planting dates (April 20 and 30; May 10 and 20) on soybean (*Glycine max* Merril) cultivation in Iran; high yields were achieved with the first two dates. This work was undertaken to assess the effects of planting dates on soybean growth and production with a view to increasing soybean yield in Kabinda.

AREA, MATERIALS AND METHODS

Area

This experiment was conducted during the 2017-2018 growing season in Kimulo, a research station of the Faculty of Agricultural Sciences at Notre Dame de Lomami University (UNILO) (843 m above sea level, 6°11' South latitude and 24°56' East longitude). The annual rainfall distribution is bimodal with a long rainy season, it runs from 15 August to 15 May and the dry season is short, it runs from 15 May to 15 August (Ngoyi et al.2020). The annual rainfall is around 1200 mm with a 9-month season, while the average annual temperature is around 25°C with high inter-annual stability.

Materials and Methods

Biological Materials: This study involved a local variety. This variety was obtained locally from farmers. It is the most cultivated in the study area.

Site Preparation, Sowing, Maintenance and Harvesting: The test was installed using a 3 repetition splot split device. The main plots consisted of planting dates (September 15,

September 21 and September 28) at 40 cm x 40 cm spacing. At the beginning of the 2017-2018 growing season, the land was ploughed with hoes. Soybean was sown at the adopted spacing, at a rate of 3 seeds per pan. The trials were carried out in pure cultivation without basic fertilization, since soybeans can be grown on poor soils with the possibility of improving them. Maintenance care consisted of weeding and humping. A total of 3 weeds were carried out from the 30th day after sowing, at 15-day intervals. At harvest, the soybean pods were harvested on the six middle lines of the plot and the seed water content was adjusted to 14%.

Observed parameters and data processing: At the beginning of the vegetation, the emergence rate was determined by the ratio of number of plants that lifted 100/the density of parcels. During vegetation, the diameter of the crown, the height of the plants at flowering and the number of flowers at flowering have been determined. At harvest, the number of pods per foot and the yield were determined. Variance analysis (ANOVA) and mean separation by the TUKEY test were used to determine the differences in seeding dates using the Minitab16 software.

RESULTS

Influence of Sowing Dates on Soybean Growth

Crown Diameter: Figure 1 show the results obtained on the collar diameter parameter in mm.

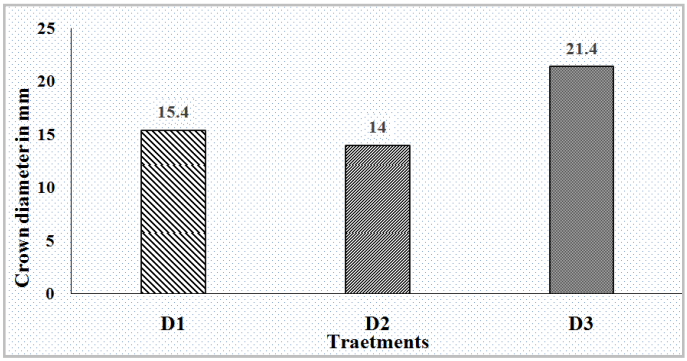

Figure 1. Crown diameter (mm) of soybean plants. D1: 15/09/2017; D2: 21/09/2017; D3: 28/09/2017

Results obtained on soybean crown diameter (Table 1.) indicate that there is no significant difference between the three sowing dates (P>0.05).

Size of plants: Figure 2 shows the results obtained on the plant size parameter in cm.

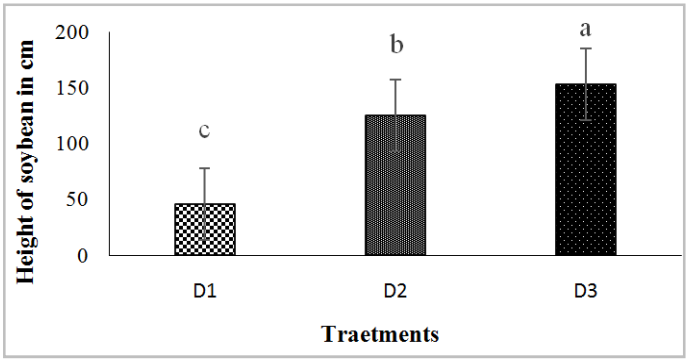

Figure 2. Height of soybean plants. D1: 15/09/2017; D2: 21/09/2017; D3: 28/09/2017

The results obtained from ANOVA on plant size indicate that there is a clearly significant date effect on plant height (P<0.05). However, plants planted on 28/09/2017 are larger than other dates. In addition, plants from 15/09/2017 have an average value in the median. On the other hand those 21/09/2017 record a lower height.

Leaf Lengths: Leaf length results by seeding date are shown in Figure 3.

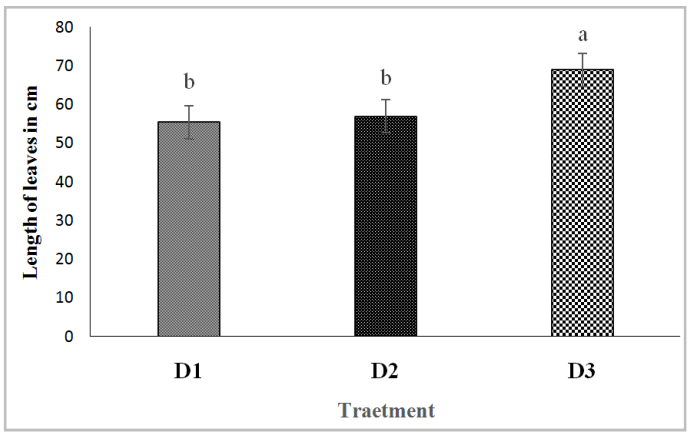

Figure 3. Leaflength in cm. D1: 15/09/2017; D2: 21/09/2017; D3: 28/09/2017

The ANOVA leaf length shows that there are significant differences between planting dates (P<0.05). Indeed, the plants from the third sowing date 28/09/2017 give long leaves than those sown on other dates.

Number of flowers

The results of flower number data by date of soybean seeding are represented in Figure 4.

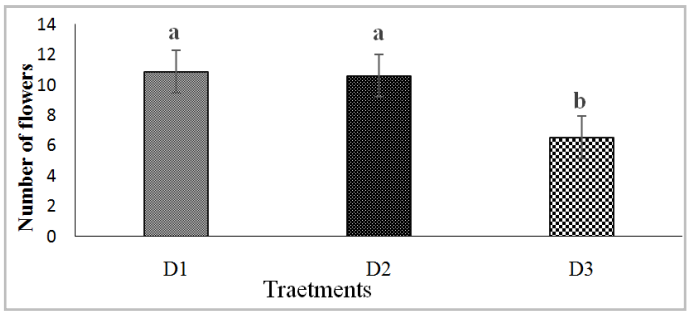

Figure 4. Number of flowers by sowing dates. D1: 15/09/2017; D2: 21/09/2017; D3: 28/09/2017

Figure 4 shows the results of the number of soybean flowers per seeding date. The variance analysis states that there is a date effect of soybean seeding (P<0.05). It turns out that plants from the first and second planting dates had a similar high number of 10,88. However, those coming from the third seeding date their average numbers remain lower at 6,53. The Tukey test allowed sowing dates to be grouped into classes (a and b).

Effects of Sowing Dates on Production Parameters

Number of pods: Results of podcounts by date of soybean plants are shown in Figure 5.

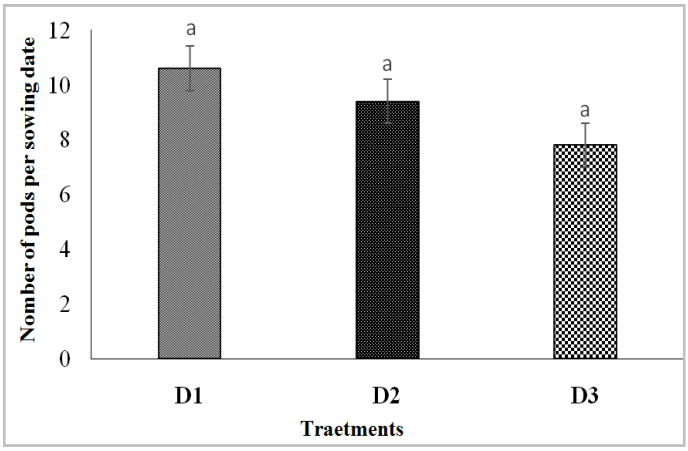

Figure 5. Number of pods per sowing date
D1: 15/09/2017; D2: 21/09/2017; D3: 28/09/2017

The results obtained from ANOVA on the number of pods indicate that there is no significant effect between the three planting dates of soybeans (P>0,05). The average values obtained on different dates remain similar.

Performance: Figure 6 shows the results obtained on the plot yield parameter.

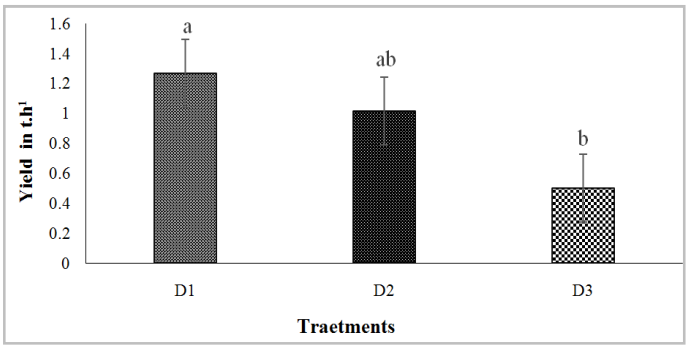

Figure 6. Effect of planting dates on soybean yield. D1: 15/09/2017; D2: 21/09/2017; D3:

The results obtained from this study have proved that early seeding led to a growth slowdown reflected by the small size for D3 (46,04 cm) while late seeding was associated with the production of tall plants (153,61cm). This situation is justified by the fact that early seeding modifies the dry matter accumulation dynamic, with «reduced» growth at the beginning of the cycle (from emergence to seed formation) but better maintained at the beginning of the cycle (Maury *et al.,* 2015).

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DISCUSSION

The results obtained from this study have proved that early seeding led to a growth slowdown reflected by the small size for D3 (46,04 cm) while late seeding was associated with the production of tall plants (153,61cm). This situation is justified by the fact that early seeding modifies the dry matter accumulation dynamic, with «reduced» growth at the beginning of the cycle (from emergence to seed formation) but better maintained at the beginning of the cycle (Konaté *et al.,* 2012). In contrast, the increase in airborne dry matter during this same period is significantly lower for very early seeding compared to conventional seeding. An adaptation of the seeding time allows the plant to meet its requirements for essential nutrients at the time of flowering activity (Baboy *et al.,* 2015); this allows soybeans to match the peak precipitation at the time of ultimate water requirement. We also note that early seeding lengthens growth by promoting earlier flowering. Thus, the crop develops more nodes, which increases the potential number of soybean pods and seeds. Indeed, a decrease in yield was observed from D1 to D2 to D3. The decrease in yield would also be associated with seed quality losses (Baboy *et al.,* 2015).In addition, a yield reduction rate of 39% was observed over the 15 days of late planting in this study. Our results are similar to those obtained by Baboy et *al*. 2015in the Lubumbashi region which recorded a 30% decrease in yield after every 15 days of delay in soybean cultivation. The same trend has been observed in some studies in America (Anderson and Vasilas, 1985)which show a yield reduction of 14-20% after the 15-day shift in seeding. It should be noted that these differences in rates are explained by the fact that the trial of the present study has been installed in an agro-ecologically different region of Lubumbashi and America. The high yield (1,2677t/ha) was obtained on seeds sown on September 15 (D1). A September 21 seedling yielded similar results of 1,2677 to 1,0167t in the same experimental field. The variance analysis did not detect a significant difference between these three sowing dates.

Conclusion

The results of this study show that late-seeding of about two weeks has an effect on soybean growth and yield. However, soybean yield increases significantly for a September 15 planting under Kabinda agro ecological conditions. For this test, a better choice of sowing time is an asset to the optimization of yield in the Kabinda region at the dawn of climate change.

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