Moroccan Journal of Agricultural Sciences
Vol 1 No 2 (2020): (March 2020)
Crop Production and Environment

Effect of planting date and sowing method on yield and grain quality of soybean (Glycine max L.) under North Sudan conditions

Galal Ahmed EL TOUM	Faculty of Agricultural Sciences, University of Dongola, Sudan
Naema Mustafa KHALIFA	Ministry of Agriculture, Northern State, Sudan, Dongola
Abdelrahim Mohamed SID AHMED	Faculty of Agricultural Sciences, University of Dongola, Sudan
Hussain Abdel Rahman IDRIS	Faculty of Agricultural Sciences, University of Dongola, Sudan

This study aimed to assess the effect of different planting dates and sowing methods on yield and grain quality of soybean. A split plot arrangement using randomized complete block with three replications was used to layout the experiment. The studied traits determining yield and grain quality, included height to first pod, no of pods/plant, 100-seed weight, harvest index, straw yield, seed yield, grain protein and oil contents. The results showed significant differences between planting dates in height to first pod, 100-seed weight, harvest index, grain yield and grain protein. Planting date in the 1st July produced 72% more grain yield than delaying planting date (15th July). Early planting date (15th June) and mid-planting date (1st July) increased grain protein of soybean by 5% than delaying planting date (15th July). Results revealed that soybean yield components were not affected by sowing methods except that of straw yield. Interaction between planting date and sowing method was significant for grain oil content.

Keywords: Soybean, planting date, sowing method, grain protein, grain yield, oil content

Introduction

Soybean has become a miracle crop of the twentieth century, often designated as ‘Golden bean’. It is a triple beneficiary crop, a unique food, a valuable feed and an industrial raw material with considerable potential. The soybean is number one in world oil production. The world production of soybean in 2017-2018 is about 346.439 million tons. The USA, Brazil, Argentina, China, India, Paraguay, Canada and Mexico are the major soybean-producing countries (USDA, 2018). Research indicates that planting date is a critical management decision that affects soybean emergence, growth characteristics, yield and grain quality (Rahman et al., 2005, Andric et al., 2007; Bastidas et al., 2008; Egli and Cornelius, 2009; Zhang et al., 2010).

A study by Pedersen (2003) in Wisconsin reported that early planting date achieved high yield. Robinson et al., (2009) observed that the greatest yields from soybean seeded in April to May in Indiana, whereas late March and early June seeding dates produced lower yields. A study by Ibrahim (2012) reported that the optimum planting date for irrigated soybean in central Sudan is mid-June. Raut et al., (2000) carried out experiments on sowing methods of soybean, particularly flat beds, ridges and furrows and raised bed sowing and reported significant higher numbers of pod per plants in raised bed sowing. Research by Lakpale and Tripathi (2012) revealed that growth parameters, yield attributes and seed yield of soybean were the highest under ridge and furrow sowing. Information on the effects of cultural practices on soybean in the Northern State of Sudan

is scarce. In addition, soybean is considered one of the most promising crops. Therefore, this study aim is to assess the effects of planting date and sowing method on yield and grain quality of soybean.

Materials and Methods

Site of experiment

A field study was carried out from 15th June to 15th November 2018 in the Demonstration Farm of the Faculty of Agricultural Sciences, University of Dongola, El Seleim village, located on the east bank of the river Nile across Dongola city-Northern State of the Sudan (Latitude 19˚ 11˝ N and Longitude 30˚ 29˝ E and altitude 227 m ASL). The Northern State occupies the distant northern part of the Sudan, where desert climate prevails with extremely high temperatures in summer and low in winter. Average minimum and maximum temperature during experimental period is presenting in table 1.

Experimental design and treatments

A Split plot arrangement using randomized complete block design with three replications was used to layout the experiment. The main plot treatment comprised three planting dates (15th June, 1st July and 15th July)whereas the sub plot treatment comprises three planting methods (Flats, ridges and raised beds).

Cultural practices and chemical analysis

Soybean variety Soya02 from Gezeira Research Station (GRS) was cultivated on three planting dates (15th June 1st July and 15th July) and harvested on 15th November. The variety is characterized by high yield, high quality, late maturing, indeterminate growth habit and suitable for irrigated areas in the Sudan (Ibrahim et al., 2017). Beuerlein (1988) reported that soybean varieties with indeterminate growth habits responded more dramatically to planting date compared to varieties with a determinate growth habits. The field was divided into three blocks (replications) each with 9 equal plots of 3m x 2m size. Sowing methods (flats, ridges and raised beds) was 50 cm apart between rows and 4 cm between plants, at a seed rate of 96 Kg/ha. Grain crude protein and oil contents were determined using standard methods of the Association of Official American Analytical Chemists (AOAC, 1990). The organic nitrogen content was determined using the micro-Kjeldahl method and an estimate of the crude protein content was obtained by multiplying the organic nitrogen content by a factor of 6.25% (Sosulski and Imafidon, 1990).

Statistical analysis

Collected data were subjected to standard procedure of analysis of variance and means separated using Least Significant Differences (LSD) method as described by Gomez and Gomez (1984) using MSTAT C software package.

Results and Discussion

Effect of planting date on yield components

The data presented in table 2 showed that planting date significantly affected soybean grain yield parameters, namely height to first pod, 100-seed weight, harvest index and grain yield. Planting date of the 1st July produced 72% more grain yield than delayed planting date (15th July). Soybean low yield resulting from late planting date was often linked with specific yield components that were highly influenced by planting date (Table 2). This result was consistent with that reported by Bhatia et al., (1999), Egli (2000) and Parker et al., (1981) which showed that low yield from late

soybean planting may be attributed to the reduction in total biomass, pods number per plant, plant height, branch number, seed number and weight.

Soybean grain quality

Planting date significantly affected soybean crude protein but there was no significant difference in oil content (Table 3). Early planting date (15th June) and mid-planting date (1st July) significantly increased crude protein by 5% than delayed planting date (15th July). Planting dates change the seed composition by changing the content of oil, protein and some other components. This result was similar to those reported by Muhammad et al., (2009) and Kumar et al., (2006). Furthermore, Ball et al., (2000) showed that soybean protein content decreased with delayed planting. In addition, Bastidas et al., (2008) reported an inconsistent effect of delayed planting on seed protein. Helms et al., (1996) determined that quality of soybean grain was reduced with delayed planting. The observed reduced oil content was in line with that reported by Tremblay et al., (2006) and Kumar et al., (2006) who reported that oil content decreased with delayed planting dates. The effect of interactions between planting date and sowing method were not significant on soybean yield components as shown in table 4.

Response of soybean yield components to planting method

Table 5 shows the response of soybean yield components to different planting methods. The results indicated that soybean yield components were not affected by sowing method with the exception of straw yield. Raised beds sowing significantly increased straw yield by 9% than flats sowing. On the other hand, there was no significant difference between flats and ridges sowing methods for this character. Higher straw yield might be due to enhanced vegetative growth of the crop resulting into more dry matter accumulation per plant. Similar findings by Autkar et al., (2006) and Lakpale et al., (2012) supports this result.

Effect of sowing method on grain quality

As shown in table 6, sowing method did not affect either protein or oil concentration. Interaction between planting date and planting method were significant for grain oil content (Figure 1).

Conclusion

In this study, early planting date often allowed the soybean plants to reach a greater proportion of their potential. However, data indicate that temperature stress in the 15th June at northern part of Sudan can affect planting date. Planting date of soybean in the 1st July is strongly recommended by this study than 15th July.

References

Andric L., T. Teklic, M. Vrataric, A. Sudaric, and V. Duvnjak (2007). Soybean seed vigor and field emergence under influence of cultivar, seed age and planting date. Cereal Research Communications, 35:177-180.

AOA (1990). Association of Official Analytical Chemist. Official Methods of Analysis, 15th ed. Washington, DC: AOAC.

Autkar K.S., Gawande R.L., Vyas, J.S. and Ghodpage R.M. (2006). Effect of land configuration on yield and water use efficiency of soybean in vertisols of Vidarbha (M.S.). Annals of Plant Physiology, 20: 158-159.

Ball R.A., L.C. Purcell and E.D. Vories (2000). Optimizing soybean plant population for a short-

season production system in the southern USA. Crop Science, 40: 757–764.

Bastidas A.M., T.D. Setryono, A. Dobermann, K.G. Cassman, R.W. Elmore, G.L. Graef, and J.E. Specht (2008). Soybean sowing date: The vegetative, reproductive, and agronomic impacts. Crop Science, 48:727-740.

Beuerlein J.E. (1988). Yield of indeterminate and determinate semi dwarf soybean for several planting dates row spacing's and seeding rates. Journal of Agricultural Production, 1: 300–303.

Bhatia V.S., S.P. Tiwari,and O.P. Joshi (1999). Yield and its attributes as affected by planting dates in soybean (Glycine max L.) varieties. Indian Journal of Agricultural Science, 69: 696– 699.

Egli D.B. and P.L. Cornelius (2009). A regional analysis of the response of soybean yield to planting date. Agronomy Journal, 101: 330–335.

Egli D.B. and W.P. Bruening (2000). Potential of early-maturing soybean cultivars in late plantings. Agronomy Journal, 92: 532-537.

Gomez K.A. and Gomez A.A. (1984). Statistical Procedures for Agricultural Research. 3rd Edition. John Wiley. New York

Helms T.C., E. Deckard, R.J. Goos and J.W. Enz (1996). Soybean seedling emergence influenced by days of soil water stress and soil temperature. Agronomy Journal, 88: 657– 661.

Ibrahim S. E (2012). Agronomic studies on irrigated soybeans in central Sudan: II. Effect of sowing date on grain yield and yield components. International Journal of Agricultural Science, 2: 766-773.

Ibrahim S. E., Amin E.A. and Mohammed S.F. (2017). A proposal for the release of new soybean varieties for irrigated and rainfed farming in Sudan. Agricultural Research Corporation (ARC), Wad Medani. Oilseed Crops, Research Center.

Kane M.V., C.C. Steele and L.J. Grabau (1997). Early-maturing soybean cropping system .1. Yield responses to planting date. Agronomy Journal, 89: 454-458.

Kumar V., A. Rani, V. Pandey, P. Mande and G.S. Chauhan (2006). Compositional traits of soybean seeds as influenced by planting date in India. Experimental agriculture, 42: 19-28.

Lakpale R. and Tripathi R.S. (2012). Broad-bed furrow and ridge and furrow method of sowing under different seed rates of soybean (Glycine max L.) for high rainfall areas of Chhattisgarh plains. Soybean Research, 10: 52-59.

Muhammad A., S.K. Khalil, K.B. Marwat, A.Z. Khan, I.H. Khalil, Amanullah and S. Arifullah (2009). Nutritional quality and production of soybean land races and improved varieties as affected by planting dates. Pakistan Journal of Botany, 41: 683-689.

Parker, M.B., W.H. Marchant, and B.J. Mullinix. (1981). Date of planting and row spacing effects on four soybean cultivars. Agronomy. Journal. 73(5): 759–762.

Pedersen P. (2003). Soybean agronomic response to management systems in the upper Midwest. Agronomy Journal, 95: 1146–1151.

Rahman M.M., J.G. Hampton and M.J. Hill (2005). The effect of time of sowing on soybean seed quality. Seed Science Technology, 33: 687–697.

Raut V. M., Taware S.P., Halvankar G.B. and Varghese P. (2000). Comparison of different sowing

methods in soybean. Journal Maharashtra Agriculture University, 25: 218-219.

Robinson A.P., S.P. Conley, J.J. Volenec and J.B. Santini (2009). Analysis of high yielding, early-planted soybean in Indiana. Agronomy Journal, 101: 131–139.

Sosulski F. W., Imafidon G. I. (1990). Amino acid composition and nitrogen – to protein conversion factors for animal plant foods. Journal of Agricultural and Food Chemistry, 38: 1351–1356.

Tremblay G.J., J.M. Beausoleil, P. Filion and M. Saulnier (2006). Response of three soybean cultivars to seeding date. Canadian Journal of Plant Science, 86: 1071–1078.

USDA (2018). Crop production annual summary. United States Department of Agriculture. Available at http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1000 (verified 20 April 2016).

Zhang, Q., Q. Gao, S.J. Herbert, Y. Li, and a M. Hashemi. (2010). Influence of sowing date on phonological stages, seed growth and marketable yield of four vegetable soybean cultivars in Northeastern USA. African Journal of Agricultural Research. 5(18): 2556–2562.

References