academicJournals

Vol. 10(9), pp. 167-171, September 2016
DOI: 10.5897/AJPS2016.1425
Article Number: 11559D860529
ISSN 1996-0824

http://www.academicjournals.org/AJPS

African Journal of Plant Science

Full Length Research Paper

Grain yield response of sesame (*Sesamum indicum* L.) to intra- and inter-row spacing under irrigated condition at Gode, Somali Regional State, Ethiopia

Fetene Muluken[1] and Alemayehu Balcha[2]*

[1]Gode Polytechnic College, Gode, Somali Regional State, Ethiopia.
[2]Hawassa Agricultural Research Centre, South Agricultural Research Institute, P.O.Box 2126, Hawassa, Ethiopia.

Received 5 May, 2016; Accepted 11 August, 2016

Sesame (*Sesamum indicum* L.) is the most important oilseed crop in Ethiopia. In the present study, efforts were made to devise appropriate crop geometry to obtain improved yield. An irrigated field experiment was conducted from December, 2014 to March, 2015 at the experimental farm of Gode Polytechnic College, Gode, Somali Regional State, Ethiopia, in order to determine grain yield and yield components using factorial combinations of five intra row (5, 10, 15, 20 and 25 cm) and four inter row (30, 40, 50 and 60 cm) spacing laid down in randomized complete block design with three replications. With the increase in intra row spacing from 5 to 25 cm, plant height (cm), primary branches/plant, capsules/plant, seed yield/plant (g), 1000-seed weight (g) and grain yield (kg/ha) increased from 101.31 to 117.87, 2.01 to 3.27, 29.17 to 43.05, 3.73 to 8.38, 2.51 to 3.63 and 648 to 1114, respectively. The respective increase in these parameters with the increase in inter row spacing from 30 to 60 cm was 100.01 to 114.71, 2.46 to 3.18, 36.33 to 42.07, 5.78 to 8.20 and 3.05 to 3.54, respectively, except that grain yield increased from 1103 to 1423 at 40 cm and then declined to 1013 at 60 cm spacing. The present study suggests that 15 x 40 cm spacing would be used to maximize grain yield of moderately branching varieties such as variety Adi.

Key words: Sesame, row spacing, grain yield, *Sesamum indicum*

INTRODUCTION

Sesame (*Sesamum indicum* L.) is the most important oilseed crop in Ethiopia. It grows from sea level up to 1500 m above sea level with uniformly distributed rainfall of about 500 to 800 mm and temperature of 20-30°C under various soil conditions (Ayana, 2015). Among oilseed crops, sesame stands first in area of production and total seed production per year. It occupies about 420,495 ha (49.14% of total area allocated to oil seeds) and produces about 288,770 tons of seed (37.99% of total oilseeds production) with average yield of 0.69 tons/ha (CSA, 2015).

The low yield of sesame has been partly attributed to inappropriate plant density, planting time, and pest pressure (weeds, diseases and insect pests)

*Corresponding author. E-mail: albalcha@yahoo.com

(Gebremichael, 2011). The establishment of an adequate plant density is critical for utilization of available growth factors such as water, light, nutrients and carbon-dioxide and to maximize grain yield. Too wide spacing leads to low plant density per unit area and reduces ground cover, whereas too narrow spacing is related to intense competition between plants for growth factors (Singh et al., 2004). In general, increase in yield has been obtained with the increase in plant density to the optimum levels (Adeyemo et al., 1992; Olowe and and Busari, 1994). On the other hand, the variation in plant density has been related to the variation in the number of capsules per plant, seed yield per plant and 1000-seed weight (Rahnama and Bakhshandeh, 2006), and plant height, number of branches per plant and seed yield (Ngala et al., 2013).

In Ethiopia, sesame grows during main rainy season as well as under irrigation during off-season commonly using 5 kg/ha seed rate and 40 x 10 cm spacing (Gebremichael, 2011). Perhaps, optimum plant density for maximum yield varies depending on plant characteristics and availability of growth factors such as water and nutrients. This experiment was conducted to determine grain yield and yield components of sesame under different intra and inter row spacing under irrigation.

MATERIALS AND METHODS

A field experiment was conducted during December, 2014 to March, 2015 under irrigation on the experimental farm of Gode Polytechnic College, Gode, Somali Regional State, Ethiopia. Gode is located at 5°57' N, 43°27'E and 300 m above sea level. It receives annual average rainfall of 325 mm and the monthly average maximum and minimum temperatures of 35.38 and 22.28°C, respectively. The main rain fall occurs from March to May (total of 186 mm) and the minor rain fall occurs from October to December (total of 128 mm). On the other hand, no rainy day was recorded during the experiment duration. The soils of the experimental site at the depth of 0-30 cm is sandy clay loam (sand 48, silt 26 and clay 26%) having pH 8.30, organic matter 0.5%, total N 0.06%, available P 27.53 ppm (Olsen), exchangeable K 1.21 cmol/kg, exchangeable sodium 0.65 cmol/kg, and CEC 14.60 cmol/kg.

The treatments consisted of factorial combinations of five intra row (5, 10, 15, 20 and 25 cm) and four inter row (30, 40, 50 and 60 cm) spacing laid down in randomized complete block design with three replications. The plot size was 3 x 3 m having distance between plots and replications of 1 and 1.5 m, respectively. The seeds of commonly grown sesame variety (Adi) were drilled on December 5, 2014 and the required spacing was maintained by thinning out excess seedlings two weeks after emergence. Plots were furrow irrigated every 5-8 days from planting up to flowering and then every 10 days up to physiological maturity. Weeds were controlled with hand weeding throughout the experiment.

Days to flowering and maturity, and plant height (cm), number of primary branches and capsules per plant (average for five random plants), number of seeds per capsule (average for three random capsules per plant), 1000-seed weight (g), seed yield per plant (g) and seed yield (kg/ha) were recorded. Data were analyzed using Genstat software (VSN International, 2012).

RESULTS

Days to flowering and maturity, plant height and branches

Days to flowering and maturity, plant height and number of primary branches per plant were significantly affected by intra and inter row spacing and also increased with increasing spacing. However, they were not significantly affected by the intra and inter row spacing interaction except days to flowering. The increase in intra row spacing from 5 to 25 cm significantly increased days to flowering from 35.25 to 44.67 (26.72), days to maturity 90.50 to 105.92 (17.04%), plant height 101.31 to 117.87 (16.35%), and primary branches per plant 2.01 to 3.27 (62.69%). The respective increase in these parameters with the increase in inter row spacing from 30 to 60 cm was 36.67 to 46.33 (26.34%), 95.67 to 105.73 (10.52%), 100.01 to 114.71 (14.70%), and 2.46 to 3.18 (29.27%) (Table 1).

Capsules, 1000-seed weight, seed yield per plant and grain yield

The effect of intra and inter row spacing was significant ($P<0.01$) for capsules/plant, 1000-seed weight, seed yield/plant and grain yield. However, they were not significantly affected by intra and inter row spacing interaction except grain yield. With the increase in intra row spacing from 5 to 25 cm, capsules/plant, 1000-seed weight (g), seed yield/plant (g), and grain yield (kg/ha) increased from 29.17 to 43.05 (47.58%), 2.51 to 3.63 (44.62%), 3.73 to 8.38 (124.66%) and 648 to 1114 (71.91%). The respective increase in these parameters with the increase in inter row spacing from 30 to 60 cm was 36.33 to 42.07 (15.80%), 3.05 to 3.54 (16.07%) and 5.78 to 8.20 (41.87%) except that grain yield increased from 1103 to 1423 (29.01%) at 40 cm and then declined to 1013 (28.81%) at 60 cm spacing (Table 2).

DISCUSSION

In the present experiment, the absence of interaction of intra- and inter-row spacing for plant height and number of branches per plant has also been reported for canola (Uzun et al., 2012). Early flowering and maturity at narrow spacing observed in this study could be because depletion of nutrients at high plant densities hastens processes of flowering and maturity. This agrees with the previous reports for potato (Getachew et al., 2012) and pearl millet (Ijoyah et al., 2015). However, non-significant effect of plant density on sesame flowering and maturity (El-Naim et al., 2010) has been reported indicating that the effect of plant density on crop phenology could vary with planting material used and location.

In the present experiment, the increase in plant height

Table 1. Significance of F-ratios and mean values of days to flowering and maturity, plant height and primary branches per plant of sesame grown at five intra and four inter row spacing.

Intra row spacing (cm)	DTF	DTM	PHT	PBP
5	35.25	90.50	101.31	2.01
10	38.83	94.75	107.45	2.80
15	43.42	104.58	110.63	2.87
20	44.50	105.58	115.29	3.23
25	44.67	105.92	117.87	3.27
Mean	41.33	100.27	110.51	2.83
$LSD_{0.05}$	1.44	2.33	9.84	0.41
Inter row spacing (cm)				
30	36.67	95.67	100.01	2.46
40	39.13	97.67	110.99	2.81
50	43.20	102.00	116.33	2.88
60	46.33	105.73	114.71	3.18
Mean	41.33	100.27	110.51	2.83
$LSD_{0.05}$	1.29	2.08	8.80	0.37
F-ratio				
Intra row(4)	**	**	*	**
Inter row(3)	**	**	**	**
Intra x inter row (12)	*	ns	ns	ns
CV (%)	4.20	2.80	10.80	17.50

DTF = days to flowering, DTM = days to maturity, PHT = plant height (cm), PBP = primary branches per plant; *, ** = significant at p<0.05 and p<0.01, respectively, ns = not significant; numbers in the parenthesis are degree of freedom.

Table 2. Significance of F-ratios and mean values of capsules per plant, 1000-seed weight, seed yield per plant and grain yield of sesame grown at five intra and four inter row spacing.

Intra row spacing (cm)	CP	TSW	SYP	GY
5	29.17	2.51	3.73	648
10	40.03	3.27	6.75	1314
15	42.16	3.57	7.95	1404
20	42.62	3.65	8.36	1320
25	43.05	3.63	8.38	1114
Mean	39.40	3.32	7.03	1160
$LSD_{0.05}$	3.23	0.21	0.64	111.60
Inter row spacing (cm)				
30	36.33	3.05	5.78	1103
40	38.75	3.26	6.69	1423
50	40.47	3.43	7.75	1102
60	42.07	3.54	8.20	1013
Mean	39.40	3.32	7.03	1160
$LSD_{0.05}$	2.88	0.19	0.57	99.80
F-ratio				
Intra row (4)	**	**	**	**

Table 2. Contd.

Inter row (3)	**	**	**	**
Intra x inter (12)	ns	ns	ns	**
CV (%)	9.90	7.80	10.90	11.60

CP = Capsules/plant, TSW = 1000-seed weight (g), SYP = seed yield/plant (g), GY= grain yield (kg/ha); *, ** = significant at p<0.05 and p<0.01, respectively, ns = not significant; numbers in the parenthesis are degree of freedom.

with the decrease in plant density could be due to less competition for nutrients and light at wider spacing. Similar results have also been reported for canola (Uzun et al., 2012), pearl millet (Ijoyah et al., 2015) and sesame (Ngala et al., 2013; Valiki et al., 2015). As to present experiment, the increase in the number of branches and capsules per plant (El Naim et al., 2010; Noorka et al., 2011) and 1000-seed weight (Rahnama and Bakhshandeh, 2006; Jakusko et al., 2013; Jan et al., 2014) with the decrease in plant density has been reported for sesame.

The increase in seed yield per plant with the decrease in plant density could be because of an increase in number of capsules per plant and 1000-seed weight at low plant density. On the other hand, the increase in grain yield with the decrease in intra and inter row spacing could be because of the increase in the number of plants per unit area. In other words, the increase in 1000-seed weight, and number of capsules and seed yield per plant could not be able to compensate for the low number of plants per unit area under wider spacing. Similar results have also been reported for sesame (Noorka et al., 2011; Umar et al., 2012; Jakusko et al., 2013; Jan et al., 2014), canola (Uzun et al., 2012), potato (Rahemi et al., 2005) and sorghum (Miko and Manga, 2008). On the other hand, the decline in grain yield below 15 cm intra row and 40 cm inter row spacing would show intense competition for nutrients and light below optimum spacing. This agrees with the previous reports for sesame (Ngala et al., 2013).

Conclusions

The present experiment indicated that: (1) capsules and seed yield plant as well as 1000-seed weight increased with the increase in both intra and inters row spacing, (2) maximum grain yield was obtained at 15 cm intra and 40 cm inter row spacing, and (3) 15 cm intra row and 40 cm inter row spacing would be used to maximize moderately branching sesame varieties such as variety Adi under irrigated conditions.

Conflict of Interests

The authors have not declared any conflict of interests.

ACKNOWLEDGEMENT

The authors thank Gode Polytechnic College, Gode, Somali Regional State, Ethiopia, for financial support provided for this study.

REFERENCES

Adeyemo MO, Ojo AO, Gungula DT (1992). Effects of plant population on some agronomic traits and seed yield of sesame. Oilseeds J. 1:35-42.

Ayana NG (2015). Status of production and marketing of Ethiopian sesame seeds (*Sesamum indicum* L.): A Review. Agric. Biol. Sci. J. 1:217-223.

CSA (2015). Agricultural sample survey 2014/2015(2007 E.C), report on area and production of major crops private peasant holdings, *meher* season). Central Statistical Agency (CSA), Volume I, Statistical Bulletin 578, May, 2015, Addis Ababa, Ethiopia.

El Naim AM, El day EM, Ahmed AA (2010). Effect of plant density on the performance of some sesame (*Sesamum indicum* L) cultivars under rainfed. Res. J. Agric. Biol. Sci. 6:498-504.

Gebremichael DE (2011). Sesame research under irrigation, In. Oilseeds-Engine for economic development, Terefe G, Wakjira A, Gorfu D (eds.). Ethiopian Institute of Agricultural Research, Addis Ababa, Ethiopia. pp.73-74.

Getachew T, Belew D, Tulu S (2012). Yield and growth parameters of potato (*Solanum tuberosum* L.) as influenced by intra row spacing and time of earthing up: In Boneya Degem district, central highlands of Ethiopia. Int. J. Agric. Res. 7:255-265.

Ijoyah MO, Hashin IK, Geza RT (2015). Effects of intra-row spacing of pearl millet (*Pennisetum glaucum* (L.) R. Br) and cropping systems on the productivity of soybean-pearl millet intercropping system in a Southern Guinea Savanna location, Nigeria. World Sci. News 18:35-48.

Jakusko BB, Usman BD, Mustapha AB (2013). Effect of row spacing on growth and yield of sesame (*Sesamum indicum* L.) in Yola, Adamawa State, Nigeria. IOSR J. Agric. Vet. Sci. 2:36-39.

Jan A, Ali S, Adail M, Khan A (2014). Growth and yield components of sesame (*Sesamum indicum* L.) as influenced by phosphorus levels under different row spacing. J. Environ. Earth Sci. 4:150-155.

Miko S, Manga AA (2008). Effect of intra-spacing and nitrogen rates on growth and yield of sorghum (*Sorghum bicolor L.*) var. ICSV 400. Prod. Agric. Technol. J. 4: 66-73.

Ngala AL, Dugje IY, Yakubu H (2013). Effect of inter-row spacing and plant density on performance of sesame (*Sesamum indicum* L.) in a Nigerian Sudan Savanna. Sci. Int. 25:513-519.

Noorka IR, Hafiz SI, El-Bramawy MAS (2011). Response of sesame to population densities and nitrogen fertilization on newly reclaimed sandy soils. Pak. J. Bot. 43:1953-1958.

Olowe VIO, Busari LD (1994). Appropriate plant population and spacing for sesame (*Sesamum indicum* L.) in the southern Guinea savanna of Nigeria. Trop. Oilseeds J. 2:18-27.

Rahemi A, Hasanpour A, Mansoori B, Zakerin A, Taghavi TS (2005). The effects of intra-row spacing and N fertilizer on the yield of two foreign potato cultivars in Iran. Int. J. Agric. Biol. 7:705-707.

Rahnama A, Bakhshandeh A (2006). Determination of optimum row-spacing and plant density for uni-branched sesame in Khuzestan province. J. Agric. Sci. Technol. 8:25-33.

Singh K, Dhaka RS, Fageria MS (2004). Response of cauliflower (*Brassica oleracea* var. *botrytis* L.) cultivars to row spacing and nitrogen fertilization. Progress. Hortic. 36:171-173.

Umar UA, Mahmud M, Abubakar IU, Babaji BA, Idris UD (2012). Performance of sesame (*Sesamum indicun* L) varieties as influenced by nitrogen fertilizer level and intra row spacing. Pac. J. Sci. Technol. 13:364-369.

Uzun B, Yol E, Furat S (2012). The influence of row and intra-row spacing to seed yield and its components of winter sown canola in the true Mediterranean type environment. Bulg. J. Agric. Sci. 18:83-91.

Valiki SRH, Ghanbari S, Golmohammadzadeh S, Kiasari KR (2015). Effect of different plant density on growth and yield of three cultivars of sesame (*Sesamum indicum* L.). Biol. Forum 7:1524-1528.

VSN International (2012). Genstat for windows, 15th ed., VSN International Ltd. U.K.