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EFFECTS OF SOWING DATE AND INTRA- ROW SPACING ON OIL, CRUDEPROTEIN, CRUDE FIBRE AND ASH CONTENTS OF SESAME (*Sesamum indicum* L.) SEED IN YOLA, NIGERIA

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ABSTRACT
Sesame (*Sesamum indicum* L.) is an important oilseed crop grown in many tropical and sub tropical areas of the world including Nigeria. However, in many areas where the crop is grown in Nigeria, sowing is always delayed until very late in the season. Also plant population has not been normally given serious consideration by farmers. To address these problems, field experiments were conducted on the Teaching and Research Farm of the Department of Crop Production and Horticulture, Modibbo Adama University of Technology, Yola, Adamwa state, Nigeria, in the 2007, 2008 and 2009 cropping seasons, to evaluate the effect of sowing date and intra-raw spacing on the oil, protein, crude fibre and ash content of sesame seeds. The experiment consisted of five sowing dates (July 17^{th,} 31st, August 14th, 28th and September 11th) as main plot treatments and six intra-row spacing (10 cm, 15 cm, 20 cm, 25 cm, 30 cm and 35 cm) giving plant population densities of 666,667, 444,444, 333,333 266,667, 222,222 and 190,476 plants ha^{-1} as subplot treatments making a total of thirty treatment combinations laid out in a randomized complete block design (RCBD) and replicated three times. The variety used was Pbtill-1. Appropriate agronomic practices recommended for the production for the crop were carried out to ensure optimum performance. Seeds harvested from each treatment were analyzed in the laboratory for oil, protein, fibre and ash content and the results subjected to analysis of variance and significant means separated using DMRT. The results showed that oil and crude protein content were favoured by sowing between July 31st and August 28th while crude fibre and ash were more when sowing was delayed till September 11th, however both were not influenced by population densities and interaction had no significant effect on oil, protein, fibre and ash content of the seeds.

KEY WORDS: Sowing date, Intra- row, Oil Content, Crude Protein, Fibre and Sesame.

INTRODUCTION

Sesame (*Sesamum indicum* L.: Pedalialeace) is believed to have originated from Africa and India (Morris, 2002: Bedigian, 2003, Bedigian, 2010). It is considered to be the oldest oilseed crop known to man grown in many parts of the world (Kafiriti and Deckers, 2001; Mahafani, *et al*., 2007). It is basically a crop of warm regions of the tropics and subtropics. In 2002, the FAO ranked it as the sixth largest in the world production among edible oilseed, with about 3.89 Mil. Metric tones and twelfth in overall world production of vegetable oil (FAO 2008). World leading producers are India, China, Myanmar, Sudan, Ethiopia, Uganda and Nigeria (Hansen, 2011). The importance of sesame lies in its high content of oil, protein, calcium, iron, and me thionine. Its odourless oil of high quality is used in the manufacture of margarine and salad oil (Hartimann *et al*., 1988) and as a carrier for fat soluble substances in pharmaceuticals (Schilling and Cattan, 1991). It is highly resistant to oxidative rancidity as it contains sesamol a compound that serves as an anti-oxidant. Its high content of protein, calcium and iron also makes it important for pregnant and lactating women while its methionine serves as a good supplement in food or feed prepared from groundnut, soybeans and other vegetable proteins that lack methionine. It is sometimes cultivated to be used as an ingredient that increases the desirable viscosity of sauces. The sauces are mixed with mashed food prepared from cereals or root crop flour, adding to the protein, vitamins and minerals contents of the predominantly starch diets of the people (Anuonye *et al*., 1998 Lewis & Elivin-Lewis, 2003). It has been reported that sesame seed kernels, dried (decorticated) contain an average of 45-61.21%, fat, 16% protein, and 11.6% dietary fibre. Agronomic practices involved in crop production have influence on the quality and quantity of the product, (Onwueme and Sinha, 1991). Weiss (1983) and Kafitiri and Deckers (2001) reported that the environmental condition under which sesame is grown influences the yield, oil and protein content of the seeds. Due to the immense importance of sesame as an oil seed crop an experiment was conducted to study the effect of sowing date and intra-row spacing on the oil, protein, fibre and ash content of sesame seeds in Yola, Adamawa State, Nigeria.

MATERIALS & METHODS

Field experiments were conducted on the Teaching and Research Farm of the Department of Crop Production and Horticulture, School of Agriculture and Agricultural Technology, Modibbo Adama University of Technology, Yola in 2007, 2008 and 2009 cropping seasons. Adamawa is in the Northern Guinea Savanna Ecological Zone of Nigeria with mean annual rainfall of 900 mm-1100 mm and mean temperature of 26.7^0C (Adebayo, 1999). Treatments consisted of five sowing dates(July 17th and 31st, August 14th and 28th and September 11th) which were assigned to the main plot and six intra-row spacing (10cm, 15cm, 20cm, 25cm, 30cm and 35cm) which made up the sub-plot treatments in a split- plot laid out in a randomized complete block design (RCBD). There were three replicates. The inter-row spacing was maintained at 30 cm and Sesame variety Pbtill-1 was used for the experiment. Appropriate agronomic practices recommended for the production of sesame like weeding, fertilizer application, pest and disease control were carried out to ensure adequate crop growth and yield. Seeds harvested from the field were then taken to the laboratory and analysed for oil, protein, fibre and ash content. Sample seeds from each plot were taken to the laboratory and oil was extracted from the seeds using the ether extractive method as described by the Association of Official Analytical Chemist (AOAC, 2005 and Onwuka, 2005). The protein content was determined using the Kjeldahl method (Harold *et al*., 1998 Onwuka, 2005 and AOAC, 2005). Crude fibre was determined using procedure described by Hennenberg, Stohmann and Rautinberg in 1804 as reported in Onwuka (2005) and AOAC (2005). Ash is the residue remaining after all the moisture has been removed as well as the organic materials (fats, proteins, carbohydrates, vitamins, organic acid etc) have been burnt away by igniting at a temperature of 500^0C as outlined by AOAC (2005) and Onwuka (2005). Data collected were subjected to analysis of Variance (ANOVA) as described by Gomez and Gomez (1984) using the mixed model procedures of Statistical Analysis System (SAS 18). Significant means were separated using Duncan's multiple range text (DMRT) at 5% level of probability.

RESULTS & DISCUSSION

Effect of treatments on oil content

The oil content of sesame was significantly influenced by sowing dates across the three seasons (Table 1). Delayed sowing resulted in up to 4.67% reduction in oil content. Percentage oil content obtained from the study ranged from 48.16% with the earliest sowing date of July 17th to 45.91% with the late sowing of September 11th across the years. Tunde-Akintunde *et al*. (2012) reported a range of 45- 50% depending on variety and the condition under which the crop was grown. It has also been reported that different varieties of sesame, cultivation climate, soil type, ripening stage, the harvesting time of the seeds and the extraction method used has an important effect on the quality and quantity of oil obtained from sesame (Elkheir *et al*., 2008 and Nigeria's Harvest, 2009). Ogbonna and Ukaan (2013) reported similar range in their studies on chemical composition and oil quality of seeds of sesame accessions grown in the Nsukka plains of South- Eastern Nigeria. Weiss (1983) reported that sesame growth, yield and seed nutritional composition was highly influenced by environment and that same variety of sesame show varying properties depending on the environment under which it was grown. Sowing date affects oil and protein contents. Other workers (Wolf *et al*., 1982; Suryavanshi *et al*., 1993 and Khan *et al*., 2001) reported similar findings in other oil seed crops like soybeans, sunflower and groundnut. Asbagh *et al*. (2009) for instance, reported that higher percentage oil was obtained in early sown sunflower than late sown. Khan *et al*. (2001) and Kafiriti and Deckers (2001) attributed to high temperature at harvest of early sown crop compared to late sown crop, Rennie and Tanner (1989) also reported that temperature of 15- 40^0C may affect the expression of genes responsible for oil content in most oil seed crops that crops which mature at high temperature produce more oil than crops that mature at low temperature, with every two weeks delay from the first sowing date of July 17th to September 11th, there was progressive reduction in percentage oil content. This could be attributed to the inability of the late sown crop to reach full maturity before there was moisture stress. Response of oil content to plant population densities was not consistent as no significant effect was observed in 2007 and 2008 seasons, although there was significant effect in 2009 and the mean analysis, where the 444, 446 plants per hectare resulted in lower percentage oil content, though significantly different only from the 190,476 plants per hectare at 35 cm intra- row spacing that resulted in the highest oil content (47.21%). This corroborated the report of Yamia (2010) that in Amaranth oil content decreased with increased plant densities, which was attributed to reduction in fat metabolic activities. The interaction between sowing date and intra-row spacing had no significant effect on percentage oil content of sesame (Table 1).

Effect of treatments on crude protein

Crude protein in sesame was found to be significantly influenced by sowing date (Table 1). Across the cropping seasons, sesame sown on July 17th, resulted in the least percentage crude protein while July 31st , August 14th ,and August 28th , gave percentage crude protein that were statistically at par and higher than July 17th and September 11th sown sesame. The highest crude protein (25.23%) was from crop sown on August 28th and the least (24.52%) by crop sown on July 17th. This was attributable to the fact that the early sown crop matured early in the season when there was still rain and high relative humidity which affected the quality of the seeds, while the late sown crop, the seeds could not fully mature to give high protein before the rains stopped. Suryavanshi *et al.* (1993) and Khan *et al*. (2001) reported similar findings and attributed this trend to the crops sown too early maturing early resulting in poor quality seeds as they are harvested when there is still rain. Across the cropping seasons in the study, plant density was found to have significantly influenced protein content, where the lower population densities resulted in higher protein content.

The highest protein content (25.02%) was obtained from sesame sown at 25cm intra- row spacing, while all the other spacing resulted in protein content that were not significantly different from each other, though the least (24.79%) was obtained from seeds produced by crops sown at 35cm intra- row (Table 1). The percentage protein obtained from this study was higher than that reported by Ogbonna and Ukaan (2013). Suryavanshi *et al.* (1993) also reported increased protein content in sesame with decrease in plant population density in India. Treatments interactions had to significant effect on crude protein content of sesame seed in the study.

TABLE 1: Percentage oil and crude protein content of sesame seed as influenced by sowing date and intra-row spacing in 2007, 2008, 2009 cropping seasons and combine in Yola.

	Percentage oil				Percentage crude protein			
Treatment	2007	2008	2009	Combined	2007	2008	2009	Combined
A: Sowing dates								
July 17th	47.32b	49.04	48.12a	48.16a	24.46a	24.72c	24.39c	24.52c
July 31st	47.89a	48.31	47.77a	47.99a	24.29ab	25.44ab	25.39a	25.04a
August 14th	46.51c	47.07c	46.72b	46.76b	24.46a	25.73a	25.51a	25.23a
August 28th	46.66c	45.91e	45.58c	46.05b	24.00b	25.55ab	25.22ab	24.92ab
September 11th	44.62d	46.34d	46.76b	45.91b	23.58c	25.39b	24.94b	24.63b
Probability of F	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
B: Intra-row spacing (cm)								
10	46.75	47.29	46.87ab	46.97ab	24.07	25.41	25.07ab	24.85ab
15	46.44	47.27	46.73b	46.81b	24.11	25.35	25.03ab	24.83ab
20	46.47	47.43	47.11ab	47.00ab	24.27	25.35	25.03ab	24.88ab
25	46.59	47.41	46.97ab	46.99ab	24.14	25.52	25.42a	25.02a
30	46.75	47.21	46.93ab	46.96ab	24.19	25.33	25.02b	24.85ab
35	46.59	47.39	47.31a	47.21a	24.17	25.23	24.97b	24.79b
Probability of F	0.5521	0.8332	0.1410	0.3179	0.9605	0.5751	0.1538	0.3513
Interaction	ns	ns	ns	ns	ns	ns	ns	ns

Means with different letters within a column of each treatment group are significantly different at 5% level using DMRT. ns = not significant.

Effect of treatments on crude fibre and ash

The results showed that crude fibre content of sesame seeds was increased with delay in sowing (Table 2). Delayed sowing of sesame by every two weeks from July 17th to September 11th resulted in increased crude fibre content of the seeds from 11.06% to 12.00% (combined results). The higher fibre percentage obtained from the late sown crop could be attributed to the inability of the crop to reach full maturity before moisture stress sets. These corroborate the findings of Reddy (2004) that late sown crops always suffer moisture stress at critical period of seed development in their life resulting in poor quality seeds. The effect of sowing date on percentage ash in sesame was significant (Table 2).

TABLE 2: The effect of sowing date and intra-row spacing on percentage crude fibre and ash content of sesame in 2007, 2008, 2009 cropping seasons and combine in Yola.

	Percentage crude fibre				Percentage ash			
Treatment	2007	2008	2009	Combined	2007	2008	2009	Combined
A: Sowing dates								
July 17th	10.87cd	11.76a	10.57d	11.06b	3.77c	3.82d	3.47d	3.69d
July 31st	10.69cd	11.30b	10.74cd	10.91c	4.31b	4.20c	4.15c	4.22c
August 14th	10.91c	11.12b	11.00bc	11.01b	4.47b	4.31c	4.39c	4.39c
August 28th	11.34b	11.49b	11.17b	11.33b	4.52b	4.84b	4.95b	4.77b
September 11th	12.81a	11.33b	11.87a	12.00a	5.18a	5.45a	5.52a	5.38a
Probability of F	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
B: Intra-row spacing (cm)								
10	11.07c	11.09	11.07	11.07	4.42ab	4.65ab	4.61ab	4.56ab
15	11.36ab	11.02	11.13	11.17	4.53ab	4.36b	4.24c	4.37c
20	11.21bc	10.52	10.93	10.87	4.69a	4.42ab	4.47abc	4.53abc
25	11.52a	11.07	11.15	11.24	4.39ab	4.69a	4.73a	4.60a
30	11.39ab	11.12	11.11	11.21	4.36b	4.44ab	4.41bc	4.41bc
35	11.40ab	10.87	11.01	11.09	4.20b	4.59ab	4.52abc	4.44abc
Probability of F	0.0024	0.5439	0.8661	0.5401	0.0109	0.0401	0.0222	0.0354
Interaction	ns	ns	ns	ns	ns	ns	ns	ns

Means with different letters within a column of each treatment group are significantly different at 5% level using DMRT, ns = not significant.

The trend in all the cropping years and the mean was similar, with late sown crop (September 11th) resulting in the highest ash (5.38%), while the earliest sown crop resulted in significantly ($p = 0.05$) lower ash. This could be attributed to

the fact that seeds obtained from the late sown crop could not reach full maturity as a moisture stress at the end of the season before the crop mature, hence reduced filling of the seeds, thereby giving more chaff. The effect of population density on crude fibre was significant only in 2007, where except for 10cm and 20cm intra –row spacing, all other intra-row spacing were statistically at par, while that of ash content was in consistent. Since the higher density reduces protein content, it follows that this will increase fibre and ash contents as the two are the left over after oil and protein have been extracted. Any factor that could lead to increased oil and protein content will lead to decrease in fibre and ash content (Khan *et al.,* 2001).There was no significant interaction effect of the treatments on crude fibre and ash contents of sesame seeds.

CONCLUSION

Percentage oil and protein content in sesame were higher in crops sown early (July 17th and 31st) and as sowing was delayed oil content decreased. Protein content was also found to be favoured by sowing between July 31st and August 28th earlier or later than this period resulted in decreased protein content of the seeds and increased crude fibre and ash content. The lower population density resulted in higher oil and protein content while increased density reduced amount of oil and protein in seeds. Therefore, for better oil and protein yield in sesame sowing should be done between July 31st and August 28th in Yola area, however population density is not significant so long as it does not exceed 666,667 plants per hectare.

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