OPEN ACCESS

Global Journal of Research in Agriculture & Life Sciences
ISSN: 2583-4576 (Online)
Volume 04| Issue 01 | Jan.-Feb. | 2024
Journal homepage: https://gjrpublication.com/gjrals/

Original Research Article

# Genotype x season interaction (GSI) and characters associations for some growth attributes and yield of sesame (*Sesamumindicum.L*) under rain-fed conditions

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**DOI:** 10.5281/zenodo.10576109 **Submission Date:** 08 Dec. 2023 | **Published Date:** 28 Jan. 2024

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## Abstract

The present study was conducted for two rainy seasons, 2021/22 and 2022/23 in order to estimate genotype × season interaction and to assess character associations for various growth attributes and yield of sesame under rain-fed conditions at Gadarif state, Sudan. The studied parameters were number of days to 50% flowering, number of days to maturity, plant height, number of capsules per plant, 1000 seed weight (g), and seed yield (kg/ha). The experiment was laid out in a randomized complete block design with three replicates. The combined analysis of variance revealed significant (P≤ 0.05) differences at the genotypic level, for days to 50% flowering, days to maturity, capsule length, and seed yield (kg/ha). The characters, days to 50% flowering, days to maturity, plant height, number of capsules/plants, capsule length, seed yield (kg/h) showed significant differences at the season level. Whereas, days to maturity, capsule length showed significant differences at the genotype × season interaction. In the first season, the genotype Gadarif-1, scored the highest seed yield (3007.0 kg/ha), whereas, in the second season, the genotype Gezoly scored the highest seed yield (1620.0 kg/ha). The inconsistent performance for the seed yield of the genotypes over the two seasons showed by the significant GxS interaction level, necessitate selection of genotypes with wider adaptation to varying environmental conditions, in this regard, AbuNaama scored the highest yield (2019.8 kg/ha) combined over the two seasons. In both seasons, yield of the crop depicted negative significant correlation with number of days to 50% flowering and number of days to maturity. In both seasons, plant height, capsule length, showed positive significant correlation with yield (kg/ha), whereas, 1000 seed weight had a positive significant correlation with yield in the first season only. Therefore, selection of early maturing, tall plants with high number of capsules would increase the seed yield of the crop.

**Keywords:** Sesame, growth attribute, yield, genotype × season, character. Association.

# INTRODUCTION

Sesame (SesamumindicumL.) is considered as one of the ancient oilseeds crops extensively cultivated in Asia and Africa. Sesame is also known as “Queen of Oilseeds” because of its high amount of quality oil. Seeds of sesame have 50% oil, 23% protein and 15% carbohydrate (Ranganathaet al. 2012). Sesame oil has a long shelf life due to the presence of lignin such as sesamin, sesamolin, sesamol and sesaminol. Antioxidant property of these compounds prevents oxidative rancidities of oil. Other than these some other beneficial compounds like tocopherol, phytates, phytosterols and some micronutrients are also present (Bedigian, 2004). Generally, sesame grows under rain-fed conditions, from arid to semi-arid regions, where the pattern and amount of rainfall changes during its reproductive growth causing decreases in seed yield and quality (Jiang et al., 2009). Approximated cultivated area at Gadarif state of sesame was (906941 ha) and productively was (113.4 kg/fed), total yield was (130759.52 ton) (Mechanized Farming Corporation, Gadarif, Sudan 2021). The temperature in the summer (43c˚) and winter (25c˚). (Meteorologist station, Gadarif, Sudan 2021). Progress in any crop improvement project depends not only on the magnitude of genetic variability but also on the heritability and genetic advance under selection (Duttaet al. 2013). The phenotypic performance of a genotype is influenced by its genetic constituents, environments and their interactions. The detection of significant genotype x environment interaction

indicates that all phenotypic responses to changes in the environment are not the same for all genotypes. This may mean that the best genotype in one environment is not the best one in another environment. Significant genotype by environment interaction for characters viz: days to 50% flowering, days to maturity, plant height, number of branches and seeds per plant, 1000-seed weight and yield in sesame were detected by many researchers (Perkins and Jinks, 1968; and John Nair, 1993).

Correlation coefficient is a statistical measure which is used to find out the degree and direction of relationship between two or more variables. In plant breeding, correlation coefficient measures the mutual relationship between various characters and determines the component on which selection can be based for genetic improvement in yield (Singh and Narayanan, 1993). Positive and significant correlation coefficients between the various pairs of characters including yield, yield components and other morphological traits in sesame at the phenotypic and the genotypic levels were reported by many workers (Chaudhary et al, 1977; Dhamuet al, 1983 and Kandasamy et al, 1990).The main objective of this study is to evaluate genotype x season interaction and to study characters association for yield, yield components and other growth attributes for some sesame genotypes under rain- fed conditions at Gadarif State, Sudan.

## MATERIALS AND METHODS

### Experimental design and treatments:

A field experiments was conducted for two consecutive rainy seasons 2021/22-2022/23 at University of Gadarif, Demonstration Farm (UGDF), Gadarif state, Sudan. In each season a randomized complete block design (RCBD) with three replications was used for laying out the field experiment. Each block was divided into 7 plots, to which the genotypes were assigned randomly. The plot size was 5×5 meters consisting of five ridges 60 cm a part and 7 cm between plants. The material for study comprised seven genotypes of sesame collected from Agricultural Research Corporation (ARC)Gadarif, Sudan. The seeds were sown in furrow along the row manually, sowing date was on 27 July 2021 for the first season and on 22 July 2022, for the second season. The experimental area was kept free of weed in both seasons. The observations were recorded for 7 agro-morphological characters, number of days to 50% flowering (NDTFPF), number of days to maturity (NDTM), plant height(cm) (PH), number of capsules per plants (NCPP), Capsule length(cm) (CL), 1000-seeds weight(g) (1000.S.W), seed yield (kg/ha) (SY kg/ha).

**Table1: Designation, name, pedigree and description of the seven sesame genotypes used in the experiment.**

| S.N. | Designation | Name | Pedigree | Description |
|---|---|---|---|---|
| | | | | |
| 1 | A/1/9 | Ziraa-9 | Commercial variety developed by pure line selection method from local landrace material. | It is characterized by profuse branching, late flowering and maturity and white small seeds. Stable yield over a wide set of environments (Osman ,1985). |
| 2 | K2 | Kenana-2 | A selection from an introduced material (30 - 15) from Pork. Faso. | a white seeded variety, short to medium duration. (Ahmed, 2008). |
| 3 | (UCR770192) | Khidir | A selection from an introduced material. | white seeded variety, short to medium duration. (Ahmed, 2008). |
| 4 | K4 | Promo | Variety selected from introduced materials of temperate origin (Greece). | High branching, medium duration, even maturity and delayed shattering. (Ahmed et al. (1997) and Ahmed, 2008). |
| 5 | Umsh | Um Shagara | selected from segregated material of crosses between introduced and local cultivars the original seed stock of the introduced parent was from IDRC project. | It is vigorous during the vegetative growth of dark green color, highly branching, medium duration to maturity, even maturity. Seeds are white and large. (Ahmedet al.,2003). |
| 6 | Ged | Gedarif-1 | A selection from segregating materials of crosses between temperate and tropical cultivars (UCR materials). | Characterized with non-branching habit, medium - late duration to flowering and good vigorous habit of growth. (Ahmedet al.,2003). |
| 7 | SPS2003T10 | - | Single pant selection in 2003 and it's under improvement. | Non-branched habit, three capsules per leaf axial and even early maturity. Seeds are white and large. (Ali and Ahmed, 2004). |

### Statistical analysis

The collected datawere subjected to the combined analysis to estimate the variance of genotypes x season's interaction according to the standard statistical procedure described by (Gomez and Gomez 1984).The mean separation was carried out by using least significance difference (L.S.D) at 0.05 probability level, Simple correlation coefficients were calculated among each pair of the characters using statistical software (Statistix 9, version 2009).

## Results and Discussion

The combined analysis of variance revealed significant (P≤ 0.05) differences at the genotypic level, for all characters studied, except plant height, number of capsules/plants, and 1000 seed weight. The characters, number of days to 50% flowering, number of days to maturity, plant height, number of capsules/plants, capsule length, seed yield (kg/ha) showed significant differences at the season level, whereas, characters as number of days to maturity, capsule length showed significant differences at the genotype × season interaction (Table 2). This result was in accordance with results reported by (Salah and Abu-bakri 2012), (Abate *et al*. 2015), (Lal*et al*. 2016), (Bamrotiya*et al*. 2016) and (Teklu*et al*. 2017) The significant interaction for the above mentioned characters suggest that the ranking of the genotypes for these characters was not constant over the seasons. The size of the interaction components, relative to that of the genetic component, is important because it directs breeders to the most likely area of adaptation of a successful cultivar. If the interaction is large relative to the genotypic ones, the breeder would search for a genotype to meet the specific requirements of that environment. In this result, the interaction components of genotypes × seasons is smaller than the genotype components, thus breeder should search for genotypes with wider adaptability. Perkins and Jinks (1968) and (John and Nair 1993) found that the interaction of G×S is greater than genotype components for sesame grown at different environmental conditions. In this study, since the genotypic components is greater than the interaction of the GxS components, therefore, breeders should search for a genotype had wide adaptability range. In consideration of the genotype ranking performances, the earliest maturing genotype was Khidir (78.0 days), whereas, the latest one was Gadarif-1 (88.667 days), The highest yielder genotype was Abu Naama (2109.8 kg/ha), whereas, the lowest yielder was Gadarif-1(1037.3 kg/ha) (table 3). Yield is a complex polygenic quantitative character, greatly influenced by environment. Hence selection of superior genotypes based on yield is not likely to be effective. However, selection based on the components of yield, may be effective, therefore, association of plant characters with yield assumes special importance in deciding the basis of selection of desired characters. In this study, in both seasons, yield of the crop depicted negative significant correlation with number of days to 50% flowering and number of days to maturity. The plant height, capsule length, 1000 seed weight (g) showed positive significant correlation, with yield, in the first season only. However, plant height, capsule length had positive significant correlation with yield in the second season (Table 4 a and b). Therefore, selection of early maturing, tall plants with high number of capsules would increase the seed yield of the crop. These results were confirmed with findings of (Kalaiyarasi etal, 2019 b.), (Enginet al.2010), (Gnanasekaran et al. 2008), (Ogbonna and Ukaa 2012) and (Sandipan et al. 2010). The highest genotype combined over the two season was (Abu Naama) with (2109.8 kg/ha), (Gezoly) with (2100.0 kg) ranked second, whereas, (Abu Sandog) ranked third with (1685.3kg/ha) Therefore, emphasis should be made on the first three ranked genotypes for increasing the yield of sesame in the future breeding programme.

## Conclusion

The seven sesame genotype examined over the two seasons showed significant variation for most characters studied including the yield. The inconsistent performance for the seed yield of the genotypes over the two seasons showed by the significant GxS interaction level, necessitate selection of genotypes with wider adaptation to varying environmental conditions. In this regard, Abu Naama scored the highest yield (2019.8 kg/ha) combined over the two seasons. In both seasons, yield of the crop depicted negative significant correlation with number of days to 50% flowering and number of days to maturity. The plant height, capsule length, 1000 seed weight (g) showed positive significant correlation, with yield, in the first season only. However, plant height, capsule length had a positive significant correlation with yield in the second season (Table 4b). Therefore, selection of early maturing, tall plants with high number of capsules would increase the seed yield of the crop.

**Table (2): Mean squares for the combined analysis of variance for seven characters of seven sesame genotypes for two seasons (2021/22-2022/23).**

| Characters | Genotype Df = 6 | Season Df =1 | G x season Df = 6 | Error Df = 26 |
|---|---|---|---|---|
| Number of days to 50% flowering | 19.524 *** | 298.667 *** | 2.889 NS | 1.635 |
| Number of days to maturity | 78.38 *** | 1100.60 ** | 27.65 ** | 5.48 |
| Plant height (cm) | 66.56 NS | 3300.17 *** | 31.69 NS | 39.93 |
| Number of capsules/plants | 48.11 NS | 4851.48 *** | 7.52 NS | 48.15 |

| | | | | |
|---|---|---|---|---|
| Capsule length(cm) | 0.64159 *** | 1.06881 * | 0.11492 * | 0.55 |
| 1000 seed weight (g) | 0.17778 NS | 0.38095 NS | 0.14540 NS | 0.12 |
| Seed yield (kg) | 830045 ** | 4961172 *** | 308085 NS | 114 |

*, **, *** significant at 0.05, 0.01 and 0.001 probability level, respectively
NS, not significant.

**Table (3). The means of characters for the seven sesame genotypes combined over the two seasons (2021/22-2022/23).**

| Genotypes | DTFPF | DTM | PH (cm) | NC | C L(cm) | S.W (g) | S. Y (kg/h) |
|---|---|---|---|---|---|---|---|
| Promo | 48.167 | 84.000 | 82.233 | 23.900 | 2.666 | 2.733 | 1599.8 |
| Abu Naama | 45.167 | 81.167 | 85.783 | 26.633 | 3.033 | 2.900 | 2109.8 |
| Gezoly | 47.500 | 82.333 | 82.583 | 24.600 | 3.033 | 3.133 | 2100.0 |
| Gadarif-1 | 50.000 | 88.667 | 83.033 | 32.233 | 2.216 | 2.700 | 1037.3 |
| Um shajara | 48.167 | 83.167 | 78.433 | 27.567 | 2.583 | 2.766 | 1456.3 |
| Khidir | 45.000 | 78.000 | 78.383 | 26.733 | 2.550 | 3.000 | 1629.8 |
| Abu sandog | 46.333 | 78.500 | 76.300 | 24.567 | 3.100 | 3.066 | 1685.3 |
| Mean | 47.19 | 82.262 | 80.964 | 26.605 | 2.740 | 2.900 | 1659.9 |
| SE<br>C.V%<br>Sign. Level | 1.346<br>6.99%<br>** | 2.730<br>8.13%<br>* | 4.766<br>14.42%<br>* | 5.550<br>51.1%<br>* | 0.126<br>11.3%<br>*** | 0.149<br>12.6%<br>** | 219.66<br>32.41%<br>** |

**Table (4.a). Association of the 7 characters in seven sesame genotypes season 2021/2022.**

| Characters | NTFPF | NTM | PH | NC | CL | 1000S.W |
|---|---|---|---|---|---|---|
| DTFPF | 1 | | | | | |
| DTM | 0.6209 ** | 1 | | | | |
| PH | 0.0883 NS | 0.4221 * | 1 | | | |
| NCPP | 0.1063 NS | 0.2880 NS | 0.3725 * | 1 | | |
| CL | -0.2033 NS | -0.0324 NS | 0.0610 NS | -0.2252 NS | 1 | |
| 1000.SW | -0.2348 NS | -0.1416 NS | -0.2719 NS | -0.3035 NS | 0.3010 NS | 1 |
| SY (kg/ha) | -0.6086 ** | -0.3002 NS | 0.0811 NS | -0.4116 * | 0.6415 ** | 0.4797 * |

**Table (4.b). Association of the 7charactees in the seven sesame genotypes season 2022/2023.**

| Characters | NFF | NM | PH | NC | CL | 1000 SW |
|---|---|---|---|---|---|---|
| DTFPF | 1 | | | | | |
| DTM | 0.8658*** | 1 | | | | |
| PH | 0.1222 NS | 0.3076 NS | 1 | | | |
| NCPP | 0.4166 * | 0.4271 * | 0.3806 * | 1 | | |
| CL | -0.3707 * | -0.3707 * | -0.2206 NS | -0.4055 * | 1 | |
| 1000.SW | -0.3506 NS | -0.2072 NS | -0.0201 NS | -0.1271 NS | 0.3042 NS | 1 |
| SY (kg/ha) | -0.1545 NS | -0.2029 NS | 0.3722 * | -0.1609 NS | 0.2389 NS | -0.2705 NS |

NS, *, *** not significant, significant at 0.05 and 0.001 probability levels, respectively
(NDTFPF): number of days to 50% flowering, (NDTM): number of days to maturity
(PH): plant height(cm), (NCPP): number of capsules per plants, (CL): Capsule length(cm), (1000.SW): 1000-seed weight (g), (SY kg/ha): Seed yield (kg/ha).

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**CITATION**
Ozaz MA AbdalMola, Salah BMA, & Badreldin A.M. Ahmed. (2024). Genotype x season interaction (GSI) and characters associations for some growth attributes and yield of sesame (Sesamumindicum.L) under rain-fed conditions. In Global Journal of Research in Agriculture & Life Sciences (Vol. 4, Number 1, pp. 15–19). https://doi.org/10.5281/zenodo.10576109