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THE RESPONSE OF TWO GARLIC VARIETIES (*ALLIUM SATVIUM L.*) TO DIFFERENT PLANTING DATES IN THE ARID TROPICS OF NORTHERN SUDAN.

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ABSTRACT

Experiment over two seasons, at Hudeiba Research Station in the arid region of northern Sudan, evaluated the effects of different planting dates and varieties on garlic bulb yield and quality attributes. Results indicated that early planting on 22nd. October gave the highest bulb yields of large bulbs averaged over the two seasons 8452, 6717, 5963 and 5202 kg/ha for the 22nd.October, 7th. November, 22nd. November and 7th. December, respectively. Yields decreased consistently with delayed planting. Comparing the newly developed variety, Hudeiba "S" to the local one, there were no significant differences between them in yield capacity and both were comparable in their quality attributes. Results revealed that little improvement has been achieved by mass selection over the years during the development of the variety. They also suggest that chances for garlic improvement might be enhanced through evaluating introduced genotypes from similar agroecolgical areas per se rather than selecting within already dominating genotypes where variability is usually narrow as a result of vegetative propagation.

Key words: Garlic, varieties, planting dates, yield, quality, arid tropics, Sudan.

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INTRODUCTION

Garlic (Allium satvium L.) is an important vegetable crop in Sudan. An estimated area of 3000 ha is planted annually in the northern region during the winter season (October-March) with an average yield of 5.5 – 7.0 ton/ha (Ahmed et al., 1984 and Nourai 1994). This area secures more than 90% of the national needs. However, the recent trend of exporting fresh garlic bulbs to the neighboring gulf countries is encouraging farmers to expand the production. Several management practices were found to affect yield and quality of garlic in Sudan, particularly planting date, nitrogen fertilization, clove size, method of planting and plant population (Nourai 1994 and Al-Tamimi 1997). However, the main constraints that are facing expanding production are delayed planting and the absence of high yielding varieties. Farmers usually delay planting until they are through with sowing of faba beans and transplanting the early onions. Both crops are being two main cash crops in the region. As for the varieties, only one local variety is dominating, it is medium – sized, has white bulbs and upright narrow leaves. Presumably, the variety is originally from Egypt, however, due to the vegetative propagation and narrow genetic variability, the variety has remained over years fairly stable with the exception for the remote possibility of natural mutation (Hassan 1984). For more than ten years, a program was run at Hudeiba Research Station to improve this local variety in yield and quality by mass selection. Little progress, if any, has been achieved and it was deemed necessary to compare the new selection designated Hudeiba "S" to the local variety at different planting dates (Mohamedali 1987 and 1988).

The objective of the study was to compare the newly developed garlic variety by mass selection designated Hudeiba "S" with the local one for yield and quality attributes at four planting dates of 15-day intervals beginning 22nd. October through 7th. December.

MATERIALS AND METHODS

The experiments were conducted at Hudeiba Research Station (lat. 17° 34 N, long. 33° 56 E and elevation 350 m above sea level) in

the arid region of northern Sudan during the 1986/87 and 1987/88 growing seasons. The soil at Hudeiba is aridisols and is known locally as 'karu'. It is heavy – textured, calcareous, alkaline old soil (3-8 km from the Nile River) that cracks easily due to its appreciable montmorillonitic clay content. It is low in organic matter and relatively poor in nitrogen in the top 40cm layer. Soil analysis of this layer (Saxena and Stewart, 1983), showed a pH of 8.2, EC of 0.53 mmhos/ cm, CEC 51 meq/100g, an ESP 10, 3.6% $CaCO_3$, 606 ppm. N, 0.39% organic carbon content, and a texture of 17% sand, 41% silt and 43% clay. The mean value for exchangeable K in the area is 1.28 meq/100g (AOAD 1983). Total P in the Sudanese agricultural soils is generally high. Hassan and Ayoub (1978), reported in Gezira a range of 645 – 685 ppm. The climate is tropical arid with relatively cool winters from November to February (maximum 35-30 $^{\circ}$ C, minimum 19-13 $^{\circ}$C). Rainfall occurs mainly between July and September ranging 0-200mm annually (Saxena and Stewart, 1983).

The factorial treatments were set in a randomized complete block design with four replications. Planting was done at an in-row spacing of 5 cm on ridges 60 cm apart running north – south, (El Hassan 1984) planting on both sides of the ridge. The experimental plot consisted of three ridges each of planting length of 7 and 5 m in 1986/87and 1987/88 seasons respectively. Nitrogen was applied as urea at a rate of 86 kg/ha splitted in two equal doses; one and two months after planting. The plants were irrigated weekly with weeds and thrips infestations kept at the lowest possible levels.

Harvesting was done according to the differential maturity of the planting dates. It was on 15th. and 27th. March and 3 rd. and 7th. April in 1986/87 season and on 21st. and 30th. March and 10th. and 16th. April in 1987/88 season for the 22nd. October, 7th. and 22nd. November and 7th. December plantings, respectively. Following the harvest, the total plot yield was recorded and a sample of 10 bulbs was taken at random to determine the different quality attributes, viz., average bulb weight, diameter, length, percentage of large bulbs (diameter > 3.0 cm), total soluble solids (TSS) and dry matter. The collected data was then statistically analysed.

RESULTS AND DISCUSSION

Total bulb yield

Differences in garlic bulb yields among the planting dates were significant (P = 0.05) in both seasons (Table 1). The highest bulb yield, obtained in 22nd. October planting date was significantly different from the other three planting dates in both seasons. The lowest yields were recorded for the 7th. December planting dates in both seasons.

Comparing the different planting dates in 1986/87 season, the earlier planting date gave significantly higher yield compared to each of the subsequent ones. The 7th. November planting date gave significantly higher yield compared to 22nd.November and 7th. December planting dates. However, the difference between the 22nd. November and 7th. December planting dates was not significant.

Data of 1987/88 season were similar to those of the first season with the exception that the difference between the 22nd. November and 7th. December planting dates was significant, and the 22nd. November planting date outperformed the 7th. November planting date due to unusual climatic conditions.

The results obtained were in agreement with the recommendations of Thompson and Kelly (1957) which indicated that for high yields, garlic must be planted early enough so that a large vegetative growth develops under the short photoperiod and cool temperatures. The yield potential depends to a large extend on the amount of vegetative growth made before bulbing commences.

Decreased yields with advanced planting are the result of inadequate vegetative plant development. Similar results were reported in Egypt by Maksoud et al. (1983) who found that the earlier planting on 15th. September in three locations gave an average increase in bulb yields by 37% compared to the late planting of 15th. October, whereas the increase in yield of lst. October compared to 15th. October was only 15%. In the current study increases in yields of 73, 41 and 10% in 1986/87 season and 46, 11 and 22% in 1987/88 season were recorded for the 22nd. October, 7th.

November and 22nd. November, respectively compared to the late planting of 7th. December.

Yield differences between the two varieties were nonsignificant (P = 0.05) in both seasons (Table 2). However, the newly developed variety Hudeiba 'S' showed a yield advantage of about 6% over the local one in 1986/87 season, whereas the local variety had an advantage of only 2% over Hudeiba 'S' in 1987/88 season. The two seasons averages were 6680 and 6487 kg/ha for Hudeiba 'S' and the local varieties respectively. The differences due to the variety and planting date interactions were nonsignificant (P = 0.05) in 1986/87 season but significant (P = 0.05) in 1987/88 season. It seems that 1986/87 season was more favorable, presumably, being cooler and/or conditions were more conducive for garlic production and consequently yields were higher as evident in large-sized bulbs.

Quality attributes

The quality attributes evaluated included; average bulb weight, diameter, length, percentages of large bulbs (diameter > 3.0 cm), TSS and dry matter. Data presented in Table 1 indicated that differences in bulb weight, diameter, length and percentages of large bulbs were significant (P = 0.05) among the planting dates in 1986/87 season. Higher values were obtained with earlier plantings. However, results obtained in 1987/88 season varied only slightly but the same trend was reported. Percentages of TSS and dry matter seemed to be fairly stable with different planting dates, as both characters are highly heritable (Table 1).

Different quality attributes were similar in the two varieties (Table 2). Differences in character parameters due to variety – planting date interactions were only significant (P = 0.05) in 1987/88 for average bulb weight and percentages of large bulbs by weight and number while such differences were only significant (P = 0.05) for the percentage of TSS in 1986/87 season.

Results of the study signify that little, if any, improvement has been achieved by mass selection over the years during the development of the new selection Hudeiba 'S' both in yielding

capacity and bulb quality and suggest that chances for garlic improvements by mass selection are remote. Improvement could possibly be enhanced through evaluating introduced genotypes from similar agroecological areas per se, with selection for fewer cloves as suggested by Meer (1994) or high harvest index as in the studies of Midan et al. (1992), rather than selection within already adapted genotypes where variability is usually narrow as a result of repeated vegetative propagation.

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Table 1: Effect of planting date on yield and quality attributes of garlic varieties during 1986/87 and 1987/88 seasons.[a]

Planting date	Yield kg/ha	Average bulb wt.(g)	Bulb dia (cm)	Bulb length (cm)	% large bulbs (Dia > 3.0 cm) Weight	Number	% TSS	% Dry matter
Season 1986/87:								
22nd October	10867a	24 a	3.6 a	2.9 a	81 a	62 a	38.1 a	54.8
7th November	8836 b	17 b	3.3 b	2.7 b	74 ab	53 b	37.5 ab	51.1
22nd November	6888 c	15 cd	3.2 bc	2.7 bc	64 c	41 c	37.8abc	51.9
7th December	6272 cd	12 d	3.0 d	2.5 d	53 d	32 d	36.0 d	50.1
LSD (0.05)	1263.0	2.5	0.14	0.12	8.3	7.6	0.99	NS
Season 1987/88:								
22nd October	6036 a	17 a	3.1	2.7	74 a	54 a	38.1	44.5
7th November	4598 b	14 b	3.1	2.6	63 b	38 b	37.6	43.6
22nd November	5038 c	16 ac	3.0	2.7	60 bc	40 bc	36.7	42.5
7th December	4131 d	14 bd	3.1	2.7	60 bcd	38 bcd	36.4	41.9
LSD (0.05)	432.4	1.9	NS	NS	5.4	5.4	NS	NS

[a] Within each column, values followed by a litter in common are not significantly different from each other at the P=0.05 level of significance according to the LSD test.

NS: Non significant at P = 0.05.

Table 2: Effect of garlic varieties on yield and quality attributes during 1986/87 and 1987/88 seasons.[a]

Variety	Yield kg/ha	Average bulb wt.(g)	Bulb dia (cm)	Bulb length (cm)	% large bulbs (Dia > 3.0 cm) Weight	Number	% TSS	% Dry matter
Season 1986/87:								
Local	7976	16	3.2	2.6	68	46	37.7	51.3
Hudeiba 'S'	8455	18	3.3	2.8	68	47	36.9	52.6
LSD (0.05)	NS	1.2	NS	0.06	NS	NS	NS	NS
Season 1987/88:								
Local	4998	15	3.1	2.6	63	41	36.8	43.1
Hudeiba 'S'	4905	15	3.1	2.7	65	44	37.6	43.1
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS

a

Within each column, values followed by a litter in common are not significantly different from each other at the P=0.05 level of significance according to the LSD test.

NS: Non significant at P = 0.05.

استجابة صنفين من الثوم لمواعيد زراعة مختلفة فى مناطق شمال السودان المدارية الجافة

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ملخص

في تجارب حقلية أجريت بمحطة أبحاث الحديبه في الإقليم الشمالي في السودان خلال موسمي ٨٧/٨٦ و ١٩٨٨/٨٧م ، أثرت مواعيد الزراعة المختلفة وأصناف الثوم على الإنتاجية والنوعية . أثبتت النتائج أن الزراعة المبكرة في ٢٢ أكتوبر أعطت أعلى إنتاجية من أبصال كبيرة الحجم حيث كانت المتوسطات للموسمين : ٨٤٥٢ ، ٦٧١٧ ، ٥٩٦٣ و ٥٢٠٢ كيلوجراماً للهكتار لمواعيد الزراعة في ٢٢ أكتوبر، ٧ نوفمبر ، ٢٢ نوفمبر و ٧ ديسمبر على التوالي. تناقصت الإنتاجية بصفة منتظمة مع تأخير الزراعة . أظهرت النتائج عدم وجود فروقات معنوية في الإنتاجية بين الصنف المستنبط حديثاً حديبه " S " والمحلي كما وأن الصنفين كانا متشابهين في الصفات النوعية للأبصال .

دلت النتائج أن تحسناً بسيطاً أمكن تحقيقه بالإنتخاب الإجمالي على مدى سنوات تطوير الصنف حديبه " S " ، وأعطت مؤشراً أن فرصت تحسين في الثوم يمكن أن تكون أسرع و أكثر فعالية من خلال إدخال وتقييم تراكيب وراثية من بيئات زراعية مشابهة بدلاً عن الإنتخاب في التراكيب السائدة حيث يقل التباين نتيجة للتكاثر الخضري المتكرر .