Universal Journal of Applied Science 2(3): 64-67, 2014
DOI: 10.13189/ujas.2014.020302 http://www.hrpub.org

Effect of Cultivar and Sowing Date on Okra (Abelmoschus Esculentus L. Moench.) Seed Yield

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Abstract This study was conducted during two consecutive years (2008/2009) at the Experimental farm, College of Agricultural Studies, Sudan University of Science and Technology. The effects of three sowing dates, 1st and 20th of July and 10th of August on seed yield of two okra cultivars (Khartoumia and Wad Gammer) were studied. Split plot design with cultivars as main plot and sowing date as subplot and in four replications was used. The seeds were sown on one side of 70 cm ridges and 10 cm plant spacing. All other cultural practices were done as recommended. Both vegetative growth (50% flowering) and seed yield (after pod drying) were evaluated. The results showed that late sowing (20th of July and 10th of August) had significant negative effects on both vegetative growth and seed yield of both cultivars in both years. The best vegetative growth and seed yield were obtained at 1st of July. Almost similar negative response of both cultivars to late sowing was noticed. It could be concluded that both okra growth and seed yield were significantly negative affected by late sowing (last week of July or later). Although no significant differences were noticed between the two cultivars in their response to sowing date okra cultivars might differ in their response to sowing date. Accordingly for high okra seed yield sowing on the first two weeks of July may be recommend for Khartoum State and areas of similar conditions.

Keywords Sowing Date, Okra Cultivars, Vegetative Growth, Seed Yield

1. Introduction

Okra (Abelmoschus esculentus L. Moench.) is a member of the family Malvaceae. It is a perennial herbaceous plant treated as annual. It is grown mainly for its pods which are used either, fresh, canned or dried and ground as powder. They are rich in pectin, vitamins, fibers and minerals like calcium, magnesium and potassium and have higher nutritive value compared to tomato or egg plant [1]. It is widely grown as summer vegetable in the tropics and subtropics as well as the warmer parts of the temperate zone [2]. In Sudan it is grown almost all over the country and around the year except the cold periods in winter under both irrigation and rains. The annual average area is 50 – 60 thousands hectares [3].

High yield and quality of vegetables depends on high seeds quality of improved cultivars, in addition to the optimum cultural practices. Okra seed production is not organized. The main supply of seeds is from unreliable sources. The farmers after a number of market picks of the commercial crop reserve the late pods for seeds. Such seeds are usually of low quality [4].

Sowing date as a factor affecting both plant growth and yield depends on the prevailing environmental conditions especially temperature and relative humidity. Optimum temperature, low relative humidity and low rain fall during seed maturity resulted in higher yields of quality seed of cotton and some vegetables [5], whereas, high temperature and humidity increased seed susceptibility to fungal diseases. References[6,7] concluded that environmental factors have great influence on growth and yield of crops. Time to flowering and duration of growth strongly influences the climatic adaptation and yield potential of a crop. Okra requires warm to hot weather conditions (23°C-37° C) for optimum growth and yield. Variations in both relative humidity and temperature affected both okra growth and flower production.

Determination of optimum sowing date is considered an important effort to have optimum yields. Both quantitative and qualitative traits of crops depend on sowing on the proper date and growing season [8]. In India [9] reported higher okra plants with good vegetative growth in June sowings compared to August sowings. Vigorous vegetative growth and high fruit setting were noticed in April compared to March sowings in Italy [10]. Reference [11] served that okra plant height and leaf number were significantly higher in March sowings compared to May sowings. Good vegetative growth and pod yield means high seed yield. References [12,13] reported high pod and seed yield from July sowings compared to late August and October sowings. Higher seed yield of a number of okra cultivars were obtained from June sowings compared to late July sowings [14].

In Sudan the growing season (March – June) can be devoted mainly for fresh production due to the high returns obtained during this period (early season) and to ovoid rain damage of mature pods and so seed crop produced during July and August. Sowings of July and August can be devoted for seed production, especially, when more okra grown areas are added under rain fed production. For an organized high quality seed production of improved okra cultivars an optimum sowing period should be recommended. Accordingly, this study was conducted to find the effect of sowing date on seed yield of okra cultivars and find an optimum sowing date for seed production of local okra cultivars in Khartoum State and areas of similar environmental conditions.

2. Materials and Methods

The study was conducted during two successive years (2008 and 2009) at the experimental farm of College of Agricultural Studies, Sudan University of Science and Technology, Shambat. The soil is characterized as clay loamy with high clay content, with pH of 7.5-7.7 and electrical conductivity (Ec.) of 0.42-1.6dS/m. The average maximum and minimum temperature and relative humidity during experiment period (July- November) were 37.2° C, 24.8° C, 43.2% and 37° C, 24.6° C and 40.8%, respectively(Administration of Data Service, Metrological Authority, Ministry of Science and Technology, Sudan). The average rainfall during the same period in both seasons was 21.9mm and 24.6mm, respectively.

Seeds of the okra cultivar,"Khartoumia", with a short stem (54.6 cm high) and short spiny pods and the cultivar "Wad Gammer" with long stem (102.2 cm high) and long smooth pods (both are medium maturing cultivars), were sown on one side of 70cm ridges and at 10cm spacing at three sowing dates , 1st and 20th of July and 10th of August. The experimental units were 5.6x3m plots with six ridges. Other cultural practices were done as recommended. The pods were picked as they had started to dry. Split plot design [15] in four replications with the two cultivars as main plot and the three sowing dates as sub plot was used. Both vegetative growth (as plant height, number of leaves per plant, root length and days to 50% flowering) at 50% flowering and seed yield (as number of pods per plant, number of seeds per pod and seed yield per plant and per hectare) after pod drying, were recorded. The data were analyzed using MSTATC computer soft ware package (version 3) and the means were separated using LSD at P≤ 0.05.

3. Results

As shown in Table 1 late sowing on 20th of July 10th of August had significant negative effects on plant height of both cultivars at 50% flowering in both years. It had no significant effect on leaf number of both cultivars. The highest plants and number of leaves of both cultivars were obtained at early sowing on 1st of July. The reductions in plant height of both cultivars were 14% and 32% due to late sowing on 20th of July and 10th of August, respectively. Both root growth and days to 50% flowering of both cultivars were also significantly negative affected (Table2) at the two late sowing dates (20th of July and 10th 0f August). Thus the vegetative growth of both cultivars was similarly affected by late sowing, showing that okra cultivars might have similar response to sowing date.

Table 1. Effect of sowing date on plant height and number of leaves per plant of okra cultivars Khartoumia (Kh) and Wad Gammer(WG) at 50% flowering in years 2008 and 2009

Sowing date	Year (2008)						Year (2009)					
	Plant height (cm)			No. of leaves/ plant			Plant height (cm)			No. of leaves/ plant		
	Kh	WG	Mean	Kh	WG	Mean	Kh	WG	Mean	Kh	WG	Mean
1st of July	70.2a	117.5a	93.9a	18.2a	22.0a	20.1a	81.3a	107.8a	94.6a	18.7a	22.0a	20.4a
20th of July	60.2b	101.5b	80.9b	17.2a	20.6a	19.0a	63.7bc	97.8bc	80.8bc	17.7a	18.0ab	17.4ab
10th of August	48.0c	90.6c	69.3c	16.0a	20.2a	18.1a	64.3c	98.8c	81.6c	16.3a	17.0b	16.2b

Means having alphabetical letters in common within the same column are not significantly different using LSD at P ≤ .05

Table 2. Effect of sowing date on root length and days to 50% flowering of okra cultivars Khartoumia (Kh) and Wad Gammer (WG) in years 2008 and 2009

Sowing date	Year (2008)						Year (2009)					
	Root length (cm)			Days to50% flowering			Root length (cm)			Days to 50% flowering		
	Kh	WG	Mean	Kh	WG	Mean	Kh	WG	Mean	Kh	WG	Mean
1st of July	22.5a	27.3a	24.9a	78.0a	72.6a	75.3a	14.2a	28.5a	21.4a	80.0a	75.6a	77.8a
20th of July	18.7b	22.5b	20.6b	70.0b	71.2a	70.6b	13.5a	27.5a	20.5a	73.0b	72.6b	72.8b
10th of August	15.9b	23.2b	19.6b	70.0b	67.2b	68.6b	12.7a	25.3a	19.0a	74.0b	71.0b	72.5b

Means having alphabetical letters in common within the same column are not significantly different using LSD at P ≤ .05

Table 3. Effect of sowing date on number of pods per plant and number of seeds per pod of okra cultivars Khartoumia (Kh) and Wad Gammer (WG) in years 2008 and 2009

Sowing date	Year (2008)						Year (2009)					
	No. of pods / plant			No. of seeds / pod			No. of pods/ plant			No. of seeds/ pod		
	Kh	WG	Mean	Kh	WG	Mean	Kh	WG	Mean	Kh	WG	Mean
1st of July	7.7a	7.8a	7.8a	23.0a	39.2a	26.0a	9.2a	14.5a	11.9a	15.8a	32.4a	24.1a
20th of July	6.3b	7.5a	6.9b	22.2a	35.0a	22.7a	7.0b	12.0b	9.5b	13.2a	27.7a	20.5a
10th of August	6.0b	7.5a	6.8b	22.0a	36.3a	23.7a	6.8b	11,6b	9.2b	13.8a	23.8a	18.8a

Means having alphabetical letters in common within the same column are not significantly different using LSD at P ≤ .05

Table 4. Effect of sowing date on seed yield per plant and per hectare of okra cultivars Khartoumia (Kh) and Wad Gammer (WG) in years 2008and2009

Sowing date	Year (2008)						Year (2009)					
	Seed yield/plant (g)			Seed yield/ha (kg)			Seed yield/plant (g)			Seed yield/ha (kg)		
	Kh	WG	Mean	Kh	WG	Mean	Kh	WG	Mean	Kh	WG	Mean
1st of July	5.3a	20.3a	12.8a	692.2a	2651.1a	1671.7a	7.1a	22.4a	14.8a	927.2a	2825.3a	1876.3a
20th of July	3.7b	18.5b	11.1b	483.2b	2416.0b	1449.6b	5.3b	18.2b	12.3b	718.3b	2576.8b	1647.6b
10th of August	3.5b	17.7b	10,6b	465.4b	2346.6b	1406.0b	5.0b	18.7b	11.9b	701.3b	2442.1b	1571.7b

Means having alphabetical letters in common within the same column are not significantly different using LSD at P ≤ .05

Late sowing on 20th of July and 10th of August had significant negative effects on pod number per plant but not on the number of seeds per pod (Table3) of both cultivars in both years. The highest number of pods was obtained at early sowing (1st of July). No significant differences in response to sowing date were noticed between the two cultivars.

Late sowing dates (20th of July and 10th of August) significantly reduced seed yield per plant and per hectare (Table4) in both years. The highest seed yield per plant and so per hectare was obtained at sowing on 1st of July.

4. Discussion

Late sowing after the third week of July (20th of July to 10th of August) showed significant negative effects on shoot and root growth at 50% flowering in both years. Also it reduced days to flowering i.e. induced early flowering of both cultivars. However, it has no significant effect on leaf number. That might be attributed to the decrease of temperature and increase of relative humidity during August and September in both years. Similar results were obtained by [16,17] who obtained poor seed emergence and short okra plants on late sowing in August and September compared to early sowing in July which they have also attributed to low temperature and high relative humidity during that period. Reference [9] reported higher okra plants with good vegetative growth in June sowings compared to August sowings. References [18,11] obtained vigorous okra plants in March and April sowings compared to June. References[6,7] attributed that to environmental factors which affect growth and yield of crops. They concluded that time of flowering and duration of growth strongly influenced the climatic adaptation and yield potentials of a crop.

The positive effect of early sowing (1st of July) on vegetative growth was reflected also on seed yield for both cultivars and in both years. The highest number of pods per plant and seeds per pod and seed yield per plant were obtained at early sowing (1st of July) compared to late sowing (20th of July and 10th of August). The decrease in seed yield due to late sowing could be attributed mainly to the reduced number of pods per plant (the most affected yield component by late sowing) rather than the number and weight of seeds. The low number of pods could be attributed to the fact that pollen grains viability and pod setting were most sensitive to low temperature and high relative humidity during reproductive growth (October- December). Similar results were obtained by [19,20] who pointed out that planting dates influenced both yield and yield components. Early planting resulted in highest number of pods per plant compared to late planting. Further they concluded that the trend of number of seeds per pod followed the trend of pod formation. Also [13,14] reported high pod and seed yield from June and July sowings compared to August sowings. References [21,3] obtained high okra pod number at early sowing (on 20th and 30th of June) compared to that at late sowing (on 15th and 30th of July or later). They concluded that early grown okra plants might have longer period of favorable condition (relatively high temperature and low relative humidity) for growth and development. In addition they could also withstand to a great extent unfavorable conditions during September (rains associated with onset of pests and diseases). Low temperature (34° C and 19.5° C mean maximum and minimum temperature, respectively) during flowering in November and December for late sowings, increased flower abscission and so low pod number due to low pollen viability.

It could be concluded that late sowing (20th of July and 10th of August) had significant negative effect on both okra vegetative growth and seed yield. High okra seed yield was

obtained at early sowing (1st of July). Okra cultivars might differ in their response to late sowing. However, for high okra seed yield sowing during July (on the first two weeks) could be recommended for Khartoum State and areas of similar conditions. Early sowing (March – June) could be recommended for fresh pod production since seeds produced during July- August would be affected by rain and fungal diseases.

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