Volume 11, Issue 3 (2023) pp. 151-163 **DOI**: 10.48309/ijabbr.2023.2002529.1440

Original Article

The Effect of Repeated Cutting and Sowing Date on Herbage and Seed Yield of Azivash (*Corchorus olitorius* L.), an Edible and Medicinal Plant, in the Gorgan

Seyed Roholla Hosseiny* | Mohammad Hossein Ghorbani | Farshid Ghaderi-Far

Department of Agronomy, Faculty of Plant Production, Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran

*Corresponding Author E-mail: hoseyniroh@outlook.com

Received: 2023-06-05, Revised: 2023-08-02, Accepted: 2023-08-08

Abstract

Background: Azivash (*Corchorus olitorius* L.) is an edible and medicinal plant that can be cooked either fresh or dried. It is cultivated in different regions including Asia and Africa. In the cultivation of wild okra, the possibility of obtaining herbage yield for fresh leaf consumption without negative consequence on seed yield can provide an alternative economic return. In addition, selecting a suitable sowing date to achieve the highest seed yield, can help seed producers maximize their yield per unit of land area during seed production.

Methods: To determine the effect of repeated cutting and sowing date on herbage and seed yield of Azivash (*Corchorus olitorius* L.), an experiment was conducted using a split-plot design based on a randomized complete block design with three sowing dates as the main plots, and three cutting treatments as sub-plots.

Results: The sowing date and repeated cutting had a significant effect on herbage yield, pod number per plant, seed number per pod, pod length, pod dry weight, and seed yield. In general, the treatment of not cutting (Control) on June 9th sowing date produced the highest seed yield (2,895 kg/ha). Conversely, the treatment of cutting twice on July 9th sowing date had the lowest seed yield (290 kg/ha).

Conclusion: Based on the results, it appears that the most suitable sowing date for achieving a seed yield of 2895 kg/ha is June 9th. However, if producers aim for higher income from agricultural land through dual-purpose herbage and seed production, sowing on June 9th with once cutting would result in a herbage yield of 33,467 kg/ha and a seed yield of 2,630 kg/ha in Gorgan region.

Keywords: Cutting, Herbage yield, Jute mallow, Seed yield, Sowing date.

Introduction

Azivash (*Corchorus olitorius* L.) is an edible and medicinal plant that can be cooked either fresh or dried. It is

cultivated in different regions including Asia [1] and Africa [1]. In West Africa, especially in Nigeria, it is widely cultivated as a popular plant [2]. This plant can be consumed fresh or dry and its leaves are commonly used as a vegetable. The amount of protein and minerals in the leaves of this plant was reported to be higher than the fruit and stem, while the amount of lipid and crude fiber in the fruit and stem was reported to be more than the leaves. The relatively high protein and mineral content in leaves explains the reason for the wide use of leaves in different regions, which can be a cheap and accessible source of vegetable protein. Of course, the presence of high amount of lipid in the fruit and good fiber content in the stem allows for the use of all parts of this plant and makes it an important and valuable plant [3]. The fiber content in the stem of this plant explains the use of the plant as a fiber crop in some areas. Along with cotton, this plant is one of the most important and cheapest commercial fiber plants in the world [4].

In general, it is not clear whether wild okra originated from Africa or from Asia. Some believe that this plant originated in the Indo-Burmese regions or India, along with several other related species. Others believe that there is more genetic diversity and a greater number of wild species in the genus *Corchorus* in Africa. However, wherever it originated, it has been cultivated for a long time on both continents and probably grows wild or as a crop in every country in tropical Africa [5]. In classical antiquity, Pliny recorded that jute plants were used as food in Ancient Egypt [6].

Wild okra also has medicinal uses, including high amounts of iron, which is useful in preventing anemia [2]. It also has antipyretic, pain-relieving, and antibacterial properties [7]. The leaves of this plant contain iron, calcium, phosphorus, zinc, and magnesium [3]. The factors affecting the choice of sowing date can be considered as climatic factors and non-climatic factors such as insects, diseases, weeds, birds, production economy, *etc*. [30].

Abd-Allah and Nasr [8] in research related to the effect of sowing date on the seed yield of wild okra plants in the Alexandria region of Egypt reported that the sowing date of mid-May produced the best seed yield. Kumar *et al.* [9] reported in research related to wild okra in the northern region of India that the sowing date of June 12th had the highest amount of seed yield components and the growth parameters decreased severely with the delay in sowing. They stated that the reason for the decrease in growth was the decrease in day length and average temperature. Das *et al.* [10] in research related to the effect of sowing date on the seed yield of wild okra plants in West Bengal reported that, out of 3 sowing dates, July 25th, August 9th, and August 24th, the sowing date of August 9th had the highest seed yield.

In the cultivation of wild okra, the possibility of obtaining herbage yield for fresh leaf consumption without negative consequence on seed yield will create an alternative economic return and maximize the yield per unit of land area by *Corchorus olitorius* seed producers during seed production [11]. The number [31], height [12], stage [13], and the date of the last cutting [23] are the main factors affecting the final seed yield and to produce seed should be taken into account.

The available reports on some vegetable plants show that cutting at different stem heights increases seed yield in Amaranth [14], faster seed maturity in bitter leaf [15], and increase seed yield in wild okra [16].

This plant introduced for the first time in Iran and named Azivash by Ghorbani *et al.* [17] after field research and ensuring the possibility of planting and harvesting

under climatic conditions of Gorgan (Golestan province).

In this research, we seek to investigate the effect of sowing date and cutting on the herbage and seed yield of edible and medicinal plant wild okra (*Corchorus olitorius* L.) in the climatic conditions of Gorgan. The purpose of determining the sowing date is to find the time to plant a cultivar or a group of cultivars similar to a plant, so that the set of environmental factors occurring at that time is suitable for the plant's growth, establishment, and survival and each stage of growth faces its favorable conditions and does not face adverse environmental conditions. The best sowing date leads to a higher yield compared to other sowing dates.

Given that the importance of seed production in agricultural and since there is no scientific research on the effect of sowing date and cutting on Azivash (Wild okra) in Iran, the aim of this study is to determine the best sowing date to produce the highest seed yield and the number of cutting for edible purposes without reducing the seed yield in Gorgan's weather conditions, which generally increases the economic yield, especially in seed production fields of this plant.

Materials and methods

To investigate the effect of sowing date and repeated cutting on the herbage and seed yield of the wild okra plant, an experiment was conducted at the research farm of Gorgan University of Agricultural Sciences and Natural Resources (longitude 54/324569, latitude 36/826151 and altitude of 100 meters above sea level). This study used a split-plot design with a randomized complete block design with 3 sowing dates (May 9th, June 9th, and July 9th) as main plots and 3 cutting treatments (no cutting (control), once time cutting and twice cutting) as sub-plots in 4 replications in the cropping season of 2019-2020. Each plot contained 6 rows with 30 cm distance between rows, and the length of each row was 5 meters. Since the seeds were insignificant (1000 seed weight about 2.5 g), more seeds were sown per square meter than the target plant density at the cultivation stage, and after seed emergence and plant establishment, seedlings were thinned along the rows at 10 cm between plants.

The first and the second cuttings were applied 60 and 90 days after sowing, respectively. The cutting treatment was performed manually by cutting from a height of 10 to 15 cm above the ground. At the time of each harvest, the total weight harvested from 1 m^2 was recorded to calculate the herbage yield in each replication for all different treatments.

Likewise, after seed maturity, all of the plants in 1 m^2 in each plot were harvested, and then the seed yield and yield components including the pod number per plant, pod length, pod dry weight, seed number per pod, and thousand seed weight were calculated. To calculate seed yield, we measured the total weight of seeds harvested from 1 m^2.

To calculate yield components, we randomly selected 10 plants and recorded each yield component. We also randomly selected 25 pods and measured their length, pod dry weight, and the percentage of seed weight to the total pod weight.

For the pod dry weight, we placed 25 pods in an oven at 70 °C for 48 h. The percentage of seed weight to the total pod weight was calculated as follows formula.

The percentage of seed weight to the total pod weight

$$= \frac{\text{The weight of seeds in 25 pods(g)}}{\text{Total weight of 25 pods (g)}} \times 100 \qquad (1)$$

To calculate the Thousand Seed Weight, we randomly selected 3 replications of 250 seeds, and then calculated the Thousand Seed Weight as follows.

$$\text{Thousand Seed Weight} = \frac{The\ weight\ of\ 250\ seeds\ (g)}{250} \times 1000 \qquad (2)$$

After data collection, the statistical analysis of data was conducted using Statistix Software. Mean comparison was performed using the least significant difference (LSD) method at a significance level of 0.05.

Results and Discussion

The results of analysis of variance showed that the effect of sowing date and repeated cutting and their interaction was significant on the pod number per plant, pod length, seed number per pod, pod dry weight, ratio of seed weight to the total pod weight, herbage yield, and seed yield, while the thousand seed weight was only affected by the number of cuttings (Table 1).

Table 1 Analysis of variance (mean square) of sowing date, cutting, and their interaction effect on pod number per plant, pod length, seed number per pod, pod dry weight, percentage of seed weight to total pod weight, thousand seed weight, herbage yield, and seed yield

Treatment	df	Pod number per plant	Pod length	Seed number per pod	Pod dry weight	Ratio of seed wt. to the pod wt.	Thousand seed weight	herbage yield	seed yield
Replications (R)	3	1.46 ns	0.01ns	4.90 ns	0.001ns	5.56 ns	0.009 ns	0.035 ns	**0.02ns**
Cutting (Cut)	2	5305.36**	1.06**	10472.60**	0.11**	300.19**	0.04**	684.993**	**5.61****
Error (Sd*R)	6	5.86	0.02	4.50	0.001	11.82	0.003	0.095	**0.02**
Sowing date (Sd)	2	4060.79**	0.36**	1614.20**	0.02**	161.27**	0.0001 ns	18.166**	**4.36****
Sd × Cut	4	229.50**	0.54**	2401.70**	0.01**	107.77**	0.01 ns	45.765**	**0.66****
Total error	18	3.81	0.03	5.00	0.001	6.33	0.004	0.109	**0.006**
CV (%)	-	4.37	3.18	1.29	9.96	4.60	3.79	1.33	**5.16**

**N s, ** and *, not-significant, significant at 1% and 5% level, respectively*

Table 2 Mean square of pod number per plant, pod length, seed number per pod, dry weight of the pod, percentage of seed weight to total pod weight, herbage yield, and seed yield under interaction effect of sowing date and cutting

Repeated cutting	Sowing date	Pod number per plant	Pod length (cm)	Seed number per pod	Pod dry wt. (g)	Ratio of seed wt. to pod wt. (%)	Herbage yield (kg/h)	Seed yield (kg/h)
not cutting (Control)	May 9th	77.13 b	5.79 b	187.63 c	0.48 ab	58.79 a	0	2110.00 c
not cutting (Control)	June 9th	72.43 a	5.82 b	189.69 c	0.53 a	57.51 a	0	2895.00 a
not cutting (Control)	July 9th	34.25 e	5.86 b	204.68 b	0.49 b	57.06 a	0	1470.00 de
Once Cutting	May 9th	48.60 d	5.45 c	178.88 d	0.44 c	57.00 a	28210.00 c	1510.00 d
Once Cutting	June 9th	61.33 c	6.20 a	211.22 a	0.51 a	60.67 a	33467.00 a	2630.00 b
Once Cutting	July 9th	29.74 f	5.85 b	173.80 e	0.44 c	50.20 b	31500.00 b	1040.00 f
Twice Cutting	May 9th	26.11 g	5.66 bc	169.44 f	0.38 d	52.52 b	22010.00 d	1290.00 e
Twice Cutting	June 9th	24.03 e	5.50 c	146.83 g	0.37 d	47.96 c	19500.00 e	880.00 f
Twice Cutting	July 9th	7.92 h	4.78 d	103.98 h	0.20 e	40.15 d	14600.00 f	290.00 g
LSD	–	3.37	0.27	3.44	0.06	4.48	678.40	193.40

Means followed by the same letter along the column are not significantly different from one another at 5% level of probability (LSD)

Number of Pods per Plant

The interaction effect of sowing date and cutting on the number of pods per plant showed that the sowing date of June 9th with zero cutting had the highest number with an average of 82.43 pods per plant, while the sowing date July 9th with two cuttings with an average of 7.92 pods had the lowest number (Table 2).

Ghosh *et al.* [18] reported that the effect of sowing date and cutting on the number of pods per plant in wild okra was significant, and the sowing date of June 19th with an average of 39.97 pods per plant was the highest compared to other sowing dates in the West Bengal region. Kumar *et al.* [9] reported that the sowing date of June 12th had the highest number of pods per plant in wild okra plants in the northern region of India, and it decreased drastically with the delay in planting. Ahmed and Oladiran [16] reported that the effect of cutting on the number of pods in the main stem and branches of wild okra plants was significant, and cutting treatment caused a sharp decrease in the number of pods in the main stem in the northern region of Nigeria.

In the same vein, the effect of sowing date, cutting, and their interaction on the number of pods per plant was significant, and the highest number of pods per plant was obtained from the sowing date of June 9th with zero cutting, which was more than before and after it.

In addition, with the delay in planting after June 9th, the number of pods in the plant decreased drastically. The sowing date of June 9th in all 3 cutting treatments had the highest number of pods per plant. The one-time cutting reduced the pod number per plant in all 3 sowing dates, and the 2-time cutting caused a sharp decrease in the pod number per plant.

Pod Length

The results of the interaction effect of sowing date and cutting in Table 2 showed that the sowing date June 9th with one-time cutting with an average pod length of 6.20 cm was the highest among all treatments. While the sowing date of July 9th with 2-time cutting had the lowest pod length among all treatments with an average of 4.78 cm. The cutting treatment was significant on the pod length, and the 2-time cutting treatment reduced the pod length compared to the control level**and ,** this decrease was more with delay in planting. Mollah *et al.* [19] reported that the effect of cutting on the pod length of wild okra in Bangladesh and Kishoreganj region was significant.

Number of Seeds per Pod

The interaction effect of sowing date and cutting on the seed number per pod showed that the sowing date of June 9th with one-time cutting with an average of 211.22 seeds per pod had the highest and the sowing date of July 9th with 2 times cutting with an average of 103.98 seeds per pod had the lowest among all treatments (Table 2). Ghosh *et al.* [18] reported that the effect of sowing date on the seed number per pod in wild okra plants was significant, and the sowing date of June 19th with an average of 254.84 seeds per pod was highest compared to the other sowing dates in the West Bengal region. Mollah *et al.* [19] reported that the effect of cutting on the number of seeds per pod in wild okra was significant in Kishoreganj region in Bangladesh. Similarly, the effect of sowing date and cutting was significant on the number of seeds per pod in wild okra. Two cuttings caused a significant decrease in the number of seeds per pod. Alam *et al.* [20] reported that the seed number per pod is more dependent on the length and diameter of the pod. The sowing date of June 9th with one-time cutting had the highest pod length among all treatments, which could be the reason for having the highest seed number per pod**.**

Dry Weight of the Pod

The results of the interaction effect of sowing date and cutting on the dry weight of the pod in Table 2 revealed that the sowing date of June 9th with control and one-time cutting had the highest dry weight of the pod with an average of 0.53 and 0.51 grams, respectively, and were placed in group 1. Furthermore, the sowing date July 9th with two cuttings with an average dry weight of the pod was the lowest among all treatments. Ahmed and Oladiran [16] reported that the effect of cutting on the dry weight of pods in wild okra plants in the northern region of Nigeria was significant. Abdul-Rafiu *et al.* [11] reported that the effect of cutting on the dry weight of the pod in wild okra plants was significant, and the treatment without cutting with an average of 0.39 g was the highest and the treatment of 3 times cutting with an average of 0.27 g was the lowest in Nigeria and Ibadan region. The sowing date of June 9th with control and one-time cutting had the highest dry weight of the pod among all treatments, which was more than before and after it. With early and late planting, the dry weight of the pod decreased. The treatment of cutting two times caused a significant decrease in the dry weight of the pod.

Percentage of Seed Weight to the Total Pod Weight

The interaction effect of sowing date and cutting on the percentage of seed weight to total pod weight in Table 2 demonstrated that the sowing date of June 9th with one-time cutting with an average of 60.67% seed weight to total

pod weight was the highest among all treatments. The sowing date of July 9th with two cuttings with an average of 40.15% seed weight to total pod weight was the lowest among all treatments. Accordingly, with the delay in planting, the percentage of seed weight to the total pod weight decreased, and this decrease was seen more in the two cutting treatments. The cutting treatment did not have a significant effect on the sowing date of May 9th, but two cuttings on June 9th and July 9th caused a significant decrease in the percentage of seed weight to the total pod weight.

Thousand Seed Weight

The mean comparison results for the effect of cutting on the Thousand Seed Weight of wild okra in Table 3 indicated that the control group with 1.85 grams had the highest Thousand Seed Weight among different cutting treatments. 1 time and 2 times cutting treatments were placed in group 2 with Thousand Seed Weight of 1.79 and 1.65 grams, respectively.

Table 3 Mean square of Thousand Seed Weight under different cutting treatment

Treatments	Thousand Seed Weight (g)
Control	**1.85a**
Cutting once	**1.79b**
Cutting twice	**1.74b**
LSD	**0.058**

**Means followed by the same letter along the column are not significantly different from one another at 5% level of probability (LSD)*

Ahmed and Oladiran [16] reported that the effect of cutting on hundred seed weight of wild okra plants in the northern region of Nigeria was significant. Das *et al.* [10] reported that the effect of cutting on Thousand Seed Weight of wild okra plants was significant, and cutting treatment at 45 days after sowing with an average Thousand Seed Weight of 3.75 grams was the highest in the West Bengal region. Abdul-Rafiu *et al.* [11] reported that the effect of cutting on the hundred seed weight of wild okra was significant, and the control group was the highest with an average hundred seed weight of 0.162 grams and the 3 times cutting treatment with an average of 0.127 grams had the lowest in Nigeria and Ibadan region. Similarly, the effect of cutting on the Thousand Seed Weight was significant. Also, the cutting treatment decreased the Thousand Seed Weight compared to the control group, but there was no significant difference between the once and twice cutting treatments.

Herbage Yield

The interaction effect of sowing date and repeated cutting on the herbage yield of wild okra plants showed that the once cutting at sowing date June 9th had the highest herbage yield with an average of 33,467 kg/ha, and then sowing date July 9th with an average of 31500 kg/ha which was placed in group 2 (Table 2). On the other hand, the lowest herbage yield with an average of 14,600kg/ha was seen in two cuttings in the sowing date of July 9th.

Accordingly, the sowing date has a significant effect on the herbage yield of wild okra plants. Rashwan [21] reported that the effect of sowing date on the herbage yield of wild okra plants was significant, and the sowing date of April 25th had the highest herbage yield and number of branches per plant, compared

to the early planting date of February 25th in the southern region of Egypt. Haridy *et al.* [22] reported that the sowing date had a significant effect on plant and biomass weights. Also, there have been several reports on the significant effect of cutting on the herbage yield of wild okra plants.

Ahmad and Oladiran [16] reported that the effect of cutting on the number of branches and fertile branches in the wild okra plant was significant. Ghorbani and Mehghani [24], in their research to investigate the effect of sowing date on the growth of wild okra plants in the climatic conditions of Gorgan, reported that harvesting 60 days after planting on May 5th produced the highest herbage yield of 26,579 kg/ha, followed by June 5th with 23,933 kg/ha.

Mohammad al-Tah *et al.* [25] in research related to the effect of sowing date and cutting on the herbage yield of wild okra in southern Iraq reported that sowing on March 30th with cutting on June 30th had the highest herbage yield of 2.80 kg/m^2 among the other treatments. In the same vein, the sowing date, cutting, and their interaction on the herbage yield of wild okra were significant. In the once cutting, the sowing date of June 9th had the highest herbage yield, which was more than before and after it. However, in the two cuttings, the sowing date of May 9th was highest compared to other sowing dates because after the first cutting, there was enough time for the wild okra plants to grow again and produce herbage yield with suitable climate. However, with delay in planting, the herbage yield of the second harvest decreased due to a decrease in day length and average temperature.

In case of doing once cutting for leaf harvesting, sowing date June 9th is recommended for the maximum herbage yield, but in case of doing twice cutting, sowing date May 9th is recommended because of the highest herbage yield in the twice cutting and suitable climate for herbage growth again for seed production compared to other sowing dates. The amount of harvested herbage yield of wild okra from the twice cutting was lower than the first one in all 3 sowing dates, which indicates a significant decrease in herbage yield due to the cutting treatment.

Seed Yield

The interaction effect of sowing date and repeated cutting showed that the sowing date of June 9th with not cutting (control) had the highest seed yield of 2895 kg/ha and after that, the sowing date of June 9th with only cutting was in the second group with 2630 kg/ha.

The lowest treatment also belongs to the sowing date of July 9th with 2 cuttings twice with 290 kg/ha seed yields (Table 2). According to the reports of the researchers, the sowing date had a significant effect on the seed yield of wild okra plants. Kumar *et al.* [9] reported that the sowing date of June 12th had the highest seed yield of wild okra plants in the northern region of India decreased significantly with the delay in plating. The reasons for the decrease in seed yield were also reported as the decrease in day length, average temperature, and damage caused by diseases. More and Pacharne [29] in research related to the effect of sowing date on wild okra plants reported that the sowing date of June 11th had the highest seed yield (1794 kg/ha) compared to the sowing dates of July 1st (1502 kg/ha) and July 15th (1308 kg/ha).

Rekha [26] in research related to the effect of sowing date on wild okra plant reported that the seed yield was significantly affected by the sowing date and the sowing date of the first half of July with the seed yield of 1355 kg/ha was the highest among the other sowing dates in Andhra Pradesh region of India. According to the reports, the effect of cutting on the seed yield of wild okra plant

was significant. Some studies (e.g. Alam et al., [20] Mostofa et al., [28], Ahmed and Oladiran [16], Abdul-Rafiu [11], et al., 2018, Mollah et al., [19] and Madakadze, et al., [27]) reported that leaf harvesting every 7 days significantly reduced the seed yield of wild okra plant in the southern desert region of Zimbabwe. Ghosh *et al.* [18] reported that the effect of sowing date and cutting on the seed yield of wild okra plants was significant, and the sowing date of June 19th and cutting at 45 days after sowing had the highest seed yield in the West Bengal region. Das *et al.* [10] reported that the effect of sowing date and cutting on the seed yield of wild okra plants was significant, and the sowing date of August 9th with an average seed yield of 545 kg/ha was the best sowing date. In addition, cutting treatment at 45 days after sowing showed 12.05% more seed yield than cutting treatment at 30 days after sowing in the West Bengal region. Similarly, the effect of sowing date, cutting and the interaction effect of sowing date, and cutting on the seed yield of the wild okra plant was significant and the sowing date of June 9th with not cutting (Control) had the highest seed, which was more than before and after it. The reason for the lower seed yield of the early planting was the lack of suitable weather and due to the simultaneous plant growth early stages with cloudy and rainy days. Also, due to the delay in planting after June 20th, the seed yield of wild okra was greatly reduced. The reason for this reduction was that the early stages of plant growth were exposed to scalding days and in the later stages, they were exposed to shorter days compared to the sowing date of June 20th. Repeated cutting treatment decreased the seed yield in all 3 sowing dates. The once cutting treatment on the sowing date of June 9th reduced the seed yield by an average of 265 kg/ha compared to the same sowing date but not cutting treatment. If it is necessary to harvest leaves for edible purposes, this treatment is recommended because it has both leaf harvest (once cutting) and suitable seed yield (group 2 in terms of seed yield). The treatment of twice cutting in all 3 sowing dates greatly reduced the seed yield and was placed in the last 3 groups in terms of seed yield.

Table 4 Correlation between seed yield and seed compound

	1	2	3	4	5	6	7
1-Seed yield	1						
2-Pod number per plant	0.9133**	1					
3-Pod length	0.7021**	0.5720**	1				
4-Seed number per pod	0.7907**	0.6667**	0.8610**	1			
5- Dry weight of the pod	0.8045**	0.7597**	0.8399**	0.9013**	1		
6-Percentage of seed weight to the total pod weight	0.6972**	0.5902**	0.7871**	0.8714**	0.7774**	1	
7- Thousand Seed Weight	0.4577**	0.4713**	0.0963ns	0.2939ns	0.3134ns	0.2242ns	**1**

**N s, ** and *, not-significant, significant at 1% and 5% level, respectively*

Correlation

The linear correlation between seed yield and seed components was measured. According to the results, there was the highest correlation between seed yield and the number of pods per plant, which was equal to 0.91. The highest

correlation was related to dry weight of the pod and seed number per pod with 0.90, ratio of seed weight to pod weight and seed number per pod with 0.87, pod length and seed number per pod with 0.86, dry weight of pod with pod length with 0.83, and dry weight of pod and seed yield with 0.80, respectively. Mostofa *et al.* [28] reported that the seed yield of wild okra plants was highly correlated with the pod number per plant, which is similar to the results obtained from this research.

Conclusion

According to the results of this research, the interaction effect of sowing date and repeated cutting had a significant effect on pod number per plant, seed number per pod, pod length, dry weight of pod, ratio of seed weight to pod weight, herbage, and seed yield. The results showed that the most suitable sowing date for seed production of the Azivash (Wild okra) plant is not cutting (control) treatment on June 9th, which produced the highest seed yield (about 3000 kg/ha) than early (2110 kg/ha) and late (1470 kg/ha) sowing dates. The sowing date of May 9th produced low seed yield because of its early stages of growth being exposed to cloudy, rainy days, and low air temperatures at the beginning of the crop season. Likewise, the sowing date of July 9th produced lower seed yield due to the early stages of plant growth were exposed to hot days and the later stages were exposed to shorter days compared to the sowing date of June 9th.

The sowing date of June 9th was the best treatment for both seed and herbage production in not cutting (control) and once cutting treatment, but in the twice cutting treatment, herbage and seed yield decreased due to plant regrowth being exposed to the shorter days of September. In the two cuttings, the sowing date of May 9th had the highest seed yield because after the second harvest exposed to the suitable environmental conditions, the plant had enough time to regrow and produce a higher seed yield. The sowing date of July 9th with twice cutting recorded the lowest seed yield compared to the previous two sowing dates, which indicates unsuitable environmental conditions in this treatment for seed production in the Gorgan region. Since the main purpose of this research was to investigate the possibility of herbage harvesting for edible purposes with possibility of seed harvesting (dual-purpose cultivation), in total, repeated cutting treatment caused decrease in seed yield on all 3 sowing dates compare to not cutting (control). It is indicated that if the purpose of cultivation is only the maximum seed (about 3000 kg/ha) production of Azivash (wild okra) in the Gorgan region, it is recommended to use not cutting (control) treatment on May 9th, but if the purpose of cultivation is more efficiency per unit of land area, producers could use once cutting treatment in sowing date of June 9th that produced the highest herbage (about 33400 kg/ha) and acceptable seed yield (about 2600 kg/ha).

Conflict of Interest

The authors declare that they have no conflict of interest.

Consent for Publications

All authors agree to have read the manuscript and authorize the publication of the final version of the manuscript.

Availability of Data and Material

Data are available on request from the authors.

Funding

Not applicable.

Ethics Approval and Consent to Participate

The author did not use any human samples for this study. It does not need an Ethics approval and consent to participate form.

ORCID

Seyed Roholla Hosseiny
https://orcid.org/0009-0008-0837-6703
Mohammad Hossein Ghorbani
https://orcid.org/0009-0006-3387-2608
Farshid Ghaderi-Far
https://orcid.org/0000-0002-1803-3914

References

1. a) Furumoto T, Wang R, Okazaki K, Afm F, Ali MI, Kondo A, Fukui H. Antitumor promoters in leaves of jute (Corchorus capsularis and Corchorus olitorius), *Food Sci Technol Res*; 2002; 8(3):239-43. [Crossref], [Google Scholar], [Publisher]; b) Velempini P, Riddoch I, Batisani N. Seed treatments for enhancing germination of wild okra (Corchorus olitorius), *Exp Agric*; 2003 Oct; 39(4):441-7.[Crossref], [Google Scholar], [Publisher]
2. Oyedele DJ, Asonugho C, Awotoye OO. Heavy metals in soil and accumulation by edible vegetables after phosphate fertilizer application, *Electron. J. Environ. Agric. Food Chem*; 2006; 5(4):1446-53. [Google Scholar], [Publisher]
3. Ndlovu J, Afolayan AJ. Nutritional analysis of the South African wild vegetable Corchorus olitorius L, *Asian J. Plant Sci*; 2008; 7(6):615-8. [Crossref], [Google Scholar], [Publisher]
4. Roy A, Bandyopadhyay A, Mahapatra AK, Ghosh SK, Singh NK, Bansal KC, Koundal KR, Mohapatra T. Evaluation of genetic diversity in jute (Corchorus species) using STMS, ISSR and RAPD markers, *Plant breeding*; 2006 Jun; 125(3):292-7. [Crossref], [Google Scholar], [Publisher]
5. Grubben GJ, Denton OA. Plant resources of tropical Africa 2. Vegetables. Plant resources of tropical Africa 2, *Vegetables*; 2004. [Google Scholar], [Publisher]
6. Prance S G, Nesbitt M. (2004). The Cultural History of Plants. (p 31): *Routledge*, New York. [Crossref], [Publisher]
7. Adegoke AA, Adebayo-Tayo BC. Phytochemical composition and antimicrobial effects of Corchorous olitorius leaf extracts on four bacterial isolates, *J Med Plant Res*; 2009; 3(3):155-9 [Google Scholar], [Publisher]
8. Abd-Allah S. Variation and interrelationship of some Egyptian moloukhyia genotypes jew, s mallow (Corchorus oiiton'us L.), *J **Plant** Prod*; 2006 Apr 1; 31(4):2285-96. [Google Scholar], [Publisher]
9. Kumar N, Srivastava RK, Singh RK, Singh MV. Impact of sowing time and varieties on seed yield of jute in subtropical climatic zone of north eastern Uttar Pradesh, *Natl Acad Sci Lett*; 2013 Dec; 36:571-3. [Crossref], [Google Scholar], [Publisher]
10. Das H, Poddar P, Haque S, Pati S, Poddar R, Kundu CK. Seed yield and economics of white jute as influenced by different dates of sowing, spacing and topping schedule in Terai region of West Bengal, *Int J Farm Sci*; 2014; 4(4):51-8. [Google Scholar], [Publisher]
11. Abdul-Rafiu A M, Ajayi O O, Olomide O A K, Olofintoye T A J. (2018). Enhancement of herbage and seed yield in Corchorus olitorius through repeated cutting agrotechnique 1 2 1 3. Applied Tropical Agriculture, 23(2): 139-145. [PDF]
12. Bovairi M, Shokoohfar A, Abadouz GR. Effect of Cutting Height and Seed Cutting Date on Grain yield and Yield Components in Berseem Clover (Trifolium alexandrinum L.), *Research on Crop Ecophysiology*; 2016 Jun 1; 11(2):104-11. [Google Scholar], [Publisher]

13. Iannucci A. Effects of harvest management on growth dynamics, forage and seed yield in berseem clover, *Eur J Agron*; 2001 Jul 1; 14(4):303-14. [Crossref], [Google Scholar], [Publisher]
14. Abdul-Baki AA, Bryan HH, Zinati GM, Klassen W, Codallo M, Heckert N. Biomass yield and flower production in sunn hemp: Effect of cutting the main stem, *J Veg Crop Prod*; 2001 May 30; 7(1):83-104. [Crossref], [Google Scholar], [Publisher]
15. Schippers RR. African indigenous vegetables: an overview of the cultivated species 2002. [Google Scholar]
16. Ahmed M, Oladiaran JA. Effect of stem cutting and variety on shoot development and seed yield of jute mallow (Corchorus olitorious L.), *Experimental Agriculture and Horticulture*; 2012; 12(3):21-9. [Google Scholar], [Publisher]
17. Ghorbani M H, Zainli A, Rahkan R. (2012). Investigating the possibility of planting Corchorus olitorius L in the climatic conditions of Gorgan. Research project report. Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, iran. (p 20).
18. Ghosh K, Kundu MK, Chowdary KA, Patra BC. Adjustment of date of sowing and topping to improve seed yield of Olitorius jute in New Alluvial Zone of West Bengal, *J Crop Weed*; 2017; 13(2):68-72. [Google Scholar], [Publisher]
19. Mollah MA, Tareq MZ, Rafiq ZA, Sarkar SA, Hossen B. Effects of Cutting Length and Position on the Seed Yield and Quality of Tossa Jute (Corchorus olitorius L.), *The Agriculturists*; 2018 Jan 1; 16(1):13-20. [Crossref], [Google Scholar], [Publisher]
20. Alam MA, Mollah MA, Rafiq ZA, Sarker MS, Rony MN, Tareq MZ. Effect of plant age for cuttings on the growth and seed yield in late season jute under different planting spacings, *J. Expt. Biosci*; 2019; 10(2):1-8. [Google Scholar], [Publisher]
21. Rashwan AM. Effect of sowing dates and plant spacing on growth and yield of some Jew's mallow ecotypess (corchorus olitorius L.) under South Valley condition, *Assiut J. Agric. Sci*; 2011; 42:391-413. [Google Scholar], [Publisher]
22. Haridy AG, Abbas HS, Mousa AA. Growth and Yield of Some Jew's Mallow (Corchorus olitorius L.) Ecotypes as Affected by Planting Dates and Foliar Application of Gibberellic and Humic Acids, *Assiut J Agri Sci*; 2019 Mar 1; 50(1):107-24. [Crossref], [Google Scholar], [Publisher]
23. Ahmad JA, Iqbal A, Mahmood AT, Iqbal MA, Khan HZ, Abbas RN, Akbar NA, Maqsood MU. Effect of cutting management, seeding rates and sowing method on seed yield of alfalfa (Medicago sativa L.), Pak. J. Bot; 2020 Aug 1; 52(4):1449-54. [Crossref], [Google Scholar], [Publisher]
24. Ghorbani M H, Mehghani F. (2013). The effect of planting date on the growth and performance of wild okra plant in Gorgan weather conditions. The first international congress and the 13th national congress of agricultural sciences and plant breeding, Karaj, Iran.
25. Mohammad al-Taha A H, Name-Jari A, Abdullah A A A, Hamzah H A. (2007). The effect of planting date and spacing on the composition and leaf yield of wild okra plant in southern Iraq. Encyclopedia of Karbala University, 5(4): 69-73.
26. Rekha S. (2017). Weather health indices for seed production of Jute (*Corchorus Olitorius* L.) under different sowing dates. Acharya N.G. Ranga Agricultural University.
27. Madakadze RM, Kodzanayi T, Mugumwa R. Effect of plant spacing and harvesting frequency on Corchorus olitorious leaf and seed yields, *Afr Crop Sci*, 2007 October; 2007:279-282). [Google Scholar], [Publisher]
28. Mostofa MG, Al-Mamun M, Yahiya AS, Mia MM, Saha CK. Age of Cutting and Spacing Effects on Seed Yield of Tossa Jute

(Corchorus olitoriusL.), *American J Agri Sci*; 2020; 7(2):25-9. [Google Scholar], [Publisher]
29. More SM, Pacharne DP. Seed yield and economics of jute (Corchorus olitorius) as influenced by different dates of sowing, spacing and topping management, *Int J Agric Sci*; 2017; 13(1):20-4. [Crossref], [Google Scholar], [Publisher]
30. Khajapour M R. (2013). Principles and Basics of Agriculture (pp. 314-313): Academic Publishing Center of Isfahan Industrial Unit.
31. Zakir Nejad S. Determining the most suitable planting date and number of cutting for dual-purpose barley under different treatment of nitrogen fertilizer in Ahvaz weather conditions. *Physiology of Agricultural Plants*, 1(3): 24-36.

How to cite this article:
Seyed Roholla Hosseiny, Mohammad Hossein Ghorbani, Farshid Ghaderi-Far. The Effect of Repeated Cutting and Sowing Date on Herbage and Seed Yield of Azivash (*Corchorus olitorius* L.), an Edible and Medicinal Plant, in the Gorgan. *International Journal of Advanced Biological and Biomedical Research*, 2023, 11(3), 151-163.
Link: https://www.ijabbr.com/article_706759.html