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Effect of Sowing Date and Combined Phosphorous-Potassium Fertilizer rates on Growth, Yield and Yield Attributes of Okra (*Abelmoschus esculentus. L monech*)

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ABSTRACT

Objective: The field experiment was conducted with the aim of evaluating the response of sowing dates and a combined Phosphorous and potassium fertilizers (PK fertilizer) on growth and yield of okra (*Abelmoschus esculentus .L*).

Methods: The experiment involving two factors and the field was laid out fitting a randomized block design (RBD) with each treatment being replicated three times. The first factor (sowing date) was composed of three different sowing dates which were set at 20 day interval and the three sowing dates were late-July (27 July), Mid-August (August 16) and early-September (September 5). The second factor PK fertilizer constituted five different rates (0 kg/ha, 125 kg/ha, 150 kg/ha, 175 kg/ha and 200 kg/ha).

Key Findings: Results of the study showed that sowing date was found to have a significant effect on phonological, growth and yield parameters. Seeds sown during late-July produced the highest total yield (12.09 t/ha) whereas the early-September sowing date produced the highest percentage of marketable yield (99.03%). In addition to this, the PK fertilizer application also resulted in to a significant improvement of all the growth parameters and some of the yield based parameters like total yield and number of pods. The highest significant values of number of fruits (35.95) and total yield (12.6 t/ha) were obtained from 200 Kg/ha of PK fertilizers.

Conclusion: In this study, the suitable sowing date and also the best dose of the PK fertilizers were discovered. Hence it can be concluded that it is better to sow okra seeds during the late-July and the PK fertilizers should be applied at a rate of 200 kg/ha in the ratio of 3:2 for maximizing the yielding potential of the crop.

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KEYWORDS

Cultivar, PK rates, Okra, Randomized block design, Sowing dates and Yield

INTRODUCTION

Okra (*Abelmoschus esculentus (L.) Moench*) belonging to the family of Malvaceae, is an economically important annual vegetable grown from seed in tropical, subtropical and warm temperate regions [1,2]. Abyssinian center (Ethiopia) is believed to be the center of origin [2]. Despite this, the wild types of this crop have also been found around India [3]. Okra requires a long, warm and humid growing climate for better yield [4]. It is sensitive to frost and extremely low temperatures, with an optimal temperature range of 21–30°C, maximum temperature of 35°C and a minimum of 18°C [5]. Okra is the most heat and drought tolerant vegetable and can tolerate heavy clay soils and intermittent moisture but the crop is vulnerable to frost as it may harm pods [6].

Okra is mainly grown for its edible fruit that can be used both in green and dried forms. Okra is a major source of vitamins A, B, C, K, and a mineral, including iron and iodine and it is an important vegetable source of viscous fiber [7]. The tender fruits are those to be harvested and can be utilized as a cooked vegetable [8]. It also accounts for its appreciable medicinal values as it is capable of curing many ailments like peptic ulcer as indicated by Uka et al. [9] and other diseases like chronic dysentery, urino-genital disorders and goiter [10]. World average yield/ha of okra was estimated at 8.55t/ha, 10.28t/ha and 10.56t/ha in the years of 1992, 2007 and 2010 respectively [11]. In Eritrea it is mainly grown in the lowlands and the mid-lowland areas i.e. in the regions of Anseba, Debub, Northern Red Sea and Gash Barka with Gash Barka accounting for the largest area under cultivation (514 ha) with an average yield of 10t/ha [12]. As per the statistical data obtained from 2010 up to 2014 [13]; the average yield/ha in Eritrea is 8.82t/ha). This low yield is possibly due to lack of inputs (fertilizers, irrigation water and quality seed) coupled with lack of awareness about the proper dates of sowing.

Sowing date has a great impact on the productivity of okra. With the availability of various cultivars that can do well in diversified climatic conditions, it is possible to produce okra all the year round especially in the tropics. However, proper date of sowing has to be considered for every cultivar [14]. Selection of improved varieties and knowledge of precise sowing time is very crucial in okra cultivation as the plant meets favorable environmental conditions at all the growth stages, growth duration is increased, and early vegetative growth [15]. The delay in sowing exposes okra crops to a period of high proliferation of pests and diseases [16].

Fertilizer is one of the most important inputs contributing to crop production because it increases productivity and improves yield quantity and quality [17]. NPK fertilizer application is a major input that can regulate the growth and development of plants where it can enhance the leaf area [18]. Adequate NPK application can result in to production of better yield of fresh fruits [19]. Besides some nutrients like Phosphorous can also improve the resistance of the plant to cold weather and root rot diseases [20] and also helps to promote flowering and more fruit production [7]. Nitrogen, phosphorus and potassium is the basic requirement for a good/healthy crop @ 120, 90, and 60 kg/ha respectively [21]. According to Uwiringiyimana et al. (2024), okra needs 50 kg of Nitrogen per Ha, 80 kg of P_2O_5, and 50 kg of K_2O.

Therefore, this study was conducted using Pusa sawani cultivar to determine the optimum sowing date and appropriate rate of the combined fertilizers of phosphorous and potassium applied at the ratio of 3:2 for increasing production of okra.

MATERIALS AND METHODS

Study Location

The experiment was conducted at the experimental fields of Hamelmalo Agricultural College (HAC), located at 15º 55` 12.92''N latitude and 38º 27`46.9''E longitude with an altitude of 1280 meter above sea level. Average annual rainfall and temperature of the area are 459 mm and 24^{0}C respectively, while soil is sandy loam with pH ranging 6-7 (MoA, 2005).

Field Preparation, Seed Sowing, Fertilization and other Operations

Land was ploughed and harrowed using tractor mounted equipment. Then the land was divided into three blocks each having 15 plots. Plots were sunken beds of 3 x 3.6 meter dimensions forming plot size of 10.8 m^2. At the final stage of bed preparation nitrogen in a form of Urea was applied at a rate of 60 kg/ha and the whole PK (Mixed phosphorus and potassium) fertilizer treatment was added and well incorporated to the soil. A second split dose of 60 kg/ha of nitrogen was applied as raw band just before flowering.

One week before sowing date; plots were well watered, then according to the different sowing date treatments; two seeds of okra (cultivar Pusa sawani) were sown manually in every hole of depth1.5 cm. Inter and intra-raw distance was 50 and 30 cm resulting 72 plants per plot. Thinning was applied after germination for keeping one plant per hole.

Treatments and Experimental Design

The study involved two factors and the field was laid out in such a way fitting a randomized block design (RBD) with three replications. The two factors were date of sowing and PK fertilizer rates. Sowing date composed of three dates at 20 days interval. The first sowing date (S_1) Late- July (July 27), the second sowing date (S_2) mid-August (August16) and the last date (S_3) was early-September (September 5). While the five PK rates; $(PK)_1$= 0kg/ha (control), $(PK)_2$= 125kg/ha, $(PK)_3$= 150kg/ha, $(PK)_4$= 175kg/ha and $(PK)_5$= 200kg/ha, where the P:K ratio is maintained to be 3:2 for all the PK rates.

Data Collection

Six sample plants were selected using simple random sampling technique from the central four rows excluding those plants located around the border lines to minimize the border effect. These sample plants were used to measure the data on the parameters of the study.

Seedling Emergence

It was recorded by counting the number of emerged seedlings from all the seeds sown in every plot.

$$\text{Seedling emergence \%} = \frac{\text{Number of healthy seedlings emerged}}{\text{Total seeds sown}} * 100$$

Plant Height

Plant height was recorded by measuring the distance between the basal portion of the stem and the tip of the plant.

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Leaf Number and Branch Number

The leaves that were fully open and those branches comprising distinct leaves were counted.

Leaf area

It was recorded by measuring the width and length of the mature leaves and finally the leaf area was calculated by multiplying the width and length with a coefficient for broad leaves (0.85).

$$\text{Leaf area (LA)} = L*W*0.85$$

Earliness of Flowering

Tit was recorded by counting the number of days when more than 50% of the plants in every plot started to produce flowers.

Duration of Harvesting

It was measured by counting the number of days from the start to the end of harvesting.

Number of Fruits and Total Yield

The total number of fruits and the total weight obtained from throughout the entire period of harvesting were summed up to represent the parameters number of fruits and total yield.

Individual Fruit Weight

It was computed by dividing the total weight of the harvested fruits divided by the total number of fruits harvested.

Marketable Yield

It was computed by weighing those fruits with little or no blemishes with respect to the total yield obtained.

$$MY = \frac{\text{Weight of fruits with little or no blemishes}}{\text{Total yield}} * 100$$

Pod Dry Weight

Pods were dried by chopping the pods in to fine pieces and then dried in shade.

Data Analysis

Once the data was collected, it was subjected to Genstat software (2011, VSN international Ltd) for analysis and the mean comparison was made using LSD at 5% level of significance using analysis of variance (ANOVA).

RESULTS AND DISCUSSIONS

Seedling Emergence

Significant variation was observed on the seedling emergence percentage among the different sowing dates. The maximum (91.3%) and minimum (76.9%) seedling emergence percentage values were recorded from okra seeds sown during mid-August and early-September respectively (Table 1). Upon comparing the values obtained from the late-July and early- September, there was no significant variation between them whereas the values from these sowing dates were found significantly lower as compared to the seeds sown during mid- August. This could be due to temperature and humidity conditions being favorable in August for okra seed germination as it requires warm (25-30^{0}C) and humid conditions [8]. The results were similar to the findings of Amjad et al. [21] who found changes in seedling emergence percentage due to fluctuation of temperature and humidity in different sowing dates. Combined application of Phosphorous and potassium fertilizers did not produce significant effect on the seedling emergence of okra seeds. The insignificant effect of the PK fertilizers obtained from the current study was found to contradict the results of Bhende et al. [22] who found PK rates to have significant impact on germination percentage.

Earliness of Flowering

In the current study days to flowering was significantly influenced by sowing date. The earliest flowering (61.73 days) was recorded from plants whose seeds were sown during the late-July, and delayed flowering (68 days from sowing) was recorded from early-September sowing date (Table 1). This could be due to longer exposure of the plants to warmer conditions experienced by the plants whose seeds were sown during late-July as compared to mid-August and early-September sowing dates, giving rise to faster accumulation of sufficient thermal units and consequently leading to earlier initiation of flowering [19]. This finding was in dis-agreement with the results of Amjad et al. [21] who have reported insignificant difference on the earliness of flowering among the sowing dates. Aphid incidence as well as powdery mildew could be the reasons of shortened duration of harvesting in the okra plants sown on July and September respectively. Since powdery mildew is favored under moist and low temperature condition ranging 10 to 15^{0}c, it could have resulted in to shortened duration of harvesting on the plants of the September sowing date as compared to the others [23]. In spite of this, aphids which remain active if there exists erratic rainfall followed by hot weather [24], afflicted the former sowing date plants resulting in to shortening of harvesting duration. Whereas plants of August sowing date partly escaped from both. Unlike to the sowing date effect, the application of the PK fertilizer rates did not show any significant effect on earliness of flowering of okra plants (Table 1).

Treatment	**Seedling emergence %**	**Flowering earliness (days)**	**Harvesting duration (days)**
Sowing dates			
Late-July	80.3	61.73	48.53
Mid-August	91.3	62.67	62.67
Early-September	76.9	68	55.87
LSD0.05	6.4	1.37	2.72
PK fertilizer rates (Kg/ha)			
0 (control)	87.4	63.33	55
125	79.3	64.56	55.11
150	79.3	64.33	54.56
175	81.8	64.33	55.78
200	86.3	64.11	58
$LSD_{0.05}$	NS	NS	NS

Table 1: Phonological parameters affected by sowing dates and PK fertilizer rates.

Duration of Harvesting

In spite of the insignificant effect of the PK fertilizer rates on the duration of harvesting of okra pods, the effect of sowing dates was found to be significant (Table 1). The most extended duration of harvesting (62.67 days) was recorded from mid-August sowing date. The shortest duration of harvest (48.53 days), was obtained from early-September sowing date. Aphid incidence as well as powdery mildew could be the reasons of shortened duration of harvesting in the okra plants sown on late-July and early-September respectively. Since powdery mildew is favored under moist and low temperature condition ranging 10 to 15^0c, it could have resulted in to shortened duration of harvesting on the plants of the September sowing date as compared to the others [23]. In spite of this, aphids which remain active if there exists erratic rainfall followed by hot weather [24], afflicted the former sowing date plants resulting in to shortening of harvesting duration whereas plants of August sowing date partly escaped from both.

Plant Height

Both sowing date and PK fertilizer rates showed significant effect on the plant height. Plants raised from mid-August sowing were significantly taller (206.5cm compared to late-July (189.8cm) and early-September (176.9cm) sowing dates. However, there was no significant difference between the latter two dates (Table 2). The variations observed could possibly be attributed to the differences in biotic stresses resulted due to weather changes. According to Naheed et al. [25] aphid and powdery mildew stresses were also the most determinant biotic stresses that have suppressed the plant height of July and September sowing dates respectively whereas August sowing dates could have allowed the plants to somehow escape from both the biotic stresses. In line with these findings of Bake et al. [15] who have reported significant effect of the sowing dates on the growth of okra plants. In addition to this, the current outcomes were found to be in agreement with Chattopadhyay et al. [26] and Tandel et al. [27] who have reported the increase in plant heights for those sown during the incipience of the warmer periods. Similarly, plants treated with PK fertilizer at the rate of 200kg/ha were significantly taller (205.4 cm) compared to the others and the lowest value (167.7cm) was recorded from the control. This difference in plant height is possibly due to the difference in cell division and cell elongation resulted by increasing of P and K rates by being the integral components of the photosynthesis and respiration processes [20]. The results of this experiment was in disagreement with the findings of Thakur et al. [28], who found maximum plant height from lower PK rate (90:50 kg/ha).

Leaf Number

Results of the present study showed that sowing dates did not have any significant effect on the leaf number per plant (Tables 2). Contrary to this result, Amjad et al. [21] and bake et al. [15] reported significant variation among sowing dates on leaf numbers and on the overall growth parameters respectively. On the other hand PK rates showed significant variation in number of leaves with 150kg/ha of PK showing the highest leaf number (24.5), whereas the lowest leaf number (18.6) was recorded from the control. Unlike the current results, Omottoso and Shittu [29], Gloria et al. [30] reported insignificant effect of NPK rates on leaf number. Application of PK was applied (Table 2).

Leaf Area

The results as presented in Table 2 showed that both sowing date and PK fertilizer treatments had significant effect on leaf area of the plants (P>0.05). The largest leaf area (334.4cm^2) was obtained from late-July sowing compared to mid-August (221 cm^2) and early-September sowing (229 cm^2) sowing dates. This is probably due to the fact that plants raised from those seeds sown during late-July had longer exposure to warmer conditions resulting in to better photosynthetic efficiency Naheed et al. [25]. In addition to this, leaf area was observed to increase with increase of PK fertilizer rates. Significantly largest leaf area (294.6 cm^2) was recorded when 200kg/ha of PK was applied, whereas the least (205.3 cm^2) was obtained from the non-treated plants (Table 2). Compared to the non-treated plants all the PK fertilizer rates, except 125 kg/ha, showed significant variation on the leaf area value. In the study conducted by Iyagba et al. [18] application of NPK fertilizer was observed to have a significant effect on the leaf area. Similarly, Omottoso et al. [29] found an increase in NPK up to 450kg/ha tend to increase the leaf area. Even though Omottoso et al. [29] reported that it was the sole effect of nitrogen on the leaf area when applied in NPK form, Olaniyi [31] forwarded the effect of P and K on the growth aspects.

Branch Number

Results of the study revealed that the Branch number of okra plants was not significantly affected by the sowing date treatment. In line with the current findings, Mike [19] and Ashoks et al. [32] found insignificant role of sowing dates on the number of branches. The impact PK fertilizer rate was found to be significant and out of the four different rates of PK applied, 200kg/ha dose of the fertilizer recorded the highest value (6.4) whereas the lowest number of branches (4.4) was recorded from control (Table 2).

Treatment	PH (cm)	LN	BN	LA (cm^2)
Sowing dates				
Late-July	189.8	23.9	5.5	334.4
Mid-August	206.5	20.2	5.5	221.7
Early-September	176.9	22.5	6.1	229.6
$LSD_{0.05}$	15.38	NS	NS	37.69
PK fertilizer rates (Kg/ha)				
0 (Control)	167.7	18.6	4.4	205.3
125	185.4	20.4	5.4	245.5
150	199.2	24.5	5.9	285.2
175	197.7	23.8	6.3	278.9
200	205.4	23.8	6.4	294.6
$LSD_{0.05}$	19.85	4.5	1.05	48.65

Table 2: Growth parameters influenced by sowing date and PK fertilizer rates.

Number of Pods

Significant variation was noticed in the number of fruits per plant among the sowing dates, with mid-August sowing date recording highest value (34.97) followed by late-July sowing date (33.21) and the lowest number of fruits (28.13) was recorded from early-September sowing date (Table 3). Though the difference between those higher values was insignificant, they varied significantly when compared with the lowest value. The lowest number of fruits exhibited by the latest sowing date might have been due to the accumulation of insufficient thermal units that could result in to low number of flowers. This result was seen to be in harmony with research results of Dilruba et al. [33] who reported that sowing dates had a significant impact on the increment of the fruit numbers, with those sown during the hotter periods experiencing the highest values. Besides this, it was also found to be in agreement with the outcome of Naheed et al. [25] whose report was that August sowing date experienced better flowering and hence higher fruit number. Similarly, effect of PK fertilizer was also seen to influence the number of fruits significantly despite the insignificant differences obtained when making the comparisons among the four different rates other than the control. The highest number of fruits (35.95) was recorded from 200kg/ha of PK followed by 150kg/ha PK attaining a value 34.18, whereas the least number of fruits (25.04) was obtained from the control (Table 3). The marked effect of fertilizer application noticed in this research is due to the translocation of sufficient PK nutrients to the sinks assuring the fruit setting and its subsequent development. This result is found to be in disagreement with the finding of Thakur et al. [28], who have reported maximum fruit number in 150kg/ha of PK. However it was matched with the finding of Amjad et al. [21] and Firoz [34] where a significant variation occurred among the various NP fertilizer levels on the number of fruits. The effect of PK fertilizers for the increase of fruit number of okra in the present investigation was found consistent with the findings of Ahmed and Tullock-Reid [35] and Philip et al. [36] and Rahman et al. [19] reporting significant influence of NPK on number of fruits.

Individual Pod Weight

The significant variation recorded on individual fruit weight was merely attributed to the sowing date alone. The highest individual fruit weight 8.29 g was recorded by late-July sowing date followed by mid-August sowing date exhibiting 7.35 g and the minimum value (6.9 g) was obtained from early-September sowing date (Table 3). In agreement with the finding of this experiment, Dilruba et al., [33] reported that seeds sown during the warm period and subsequently exposed to warmer climatic condition tend to produce heavier fruits. The outcome of this research was also found to be in agreement with the findings of Rahman et al. [19] who have found insignificant influence of NPK on individual fruit weight.

Total Yield

Total yield was significantly influenced by the sowing dates. Although the first two dates recorded statistically similar results, both were found to exhibit a significant difference as compared to the latest date of sowing. Maximum total yield of 12.15 tons per hectare was recorded from late-July followed by mid-August attaining a value of 11.35 tons per hectare whereas the minimum value 8.69 tons per hectare was obtained from early-September sowing date (Table 3). The highest yield obtained from July sowing date is due to the increased vegetative growth, flowering and fruit development favored by the prevailing weather conditions but August sowing having been exposed to less favorable weather conditions than the former sowing it was expected to record less yield but due to the fact that it escaped from the attack of the notorious pests namely; Aphids and powdery mildew unlike the July sowing which was afflicted by aphids, it has recorded similar yield with July sown plants. The plants sown in September however experienced the lowest yield because of the unfavorable weather conditions coupled with the severe attack of Powdery mildew. In line with the current results, the outcomes of Bake et al. [15] and Zeb et al. [3] showed significant effect of the sowing dates on the yield of okra plants. The findings of the present study also fits with the result of Mike [19], Hossain et al. [37] and Dilruba et al. [33] who reported that okra sown during the warmer months significantly gave better yields as compared to cooler months.

There existed a significant difference in the total yield of okra fruits among the PK fertilizer rates with the maximum value 12.67 t/ha being recorded from 200kg/ha PK followed by 150kg/ha of PK attaining a value of 11.44 t/ha, whereas the lowest value (8.44t/ha) was recorded from the control (Table 3). The PK rate that used to experience the highest total yield was found to vary significantly only with the two lowest PK rates. The result of this experiment was observed to be in agreement with findings of Bhende et al. [22] who expressed that an increase in PK levels resulted in to increased yield of okra. The increment of total yield, which was affected by the increase of PK rates, is due to the fact that insufficient P and K results in low vegetative growth that is reflected on the total yield [31]. In contrast to the finding of this experiment, Thakur et al. [28] have reported that, the highest yield was obtained by application of 90:60 kilogram per hectare of P_2O_5 and K_2O respectively. Firoz [34] agreed with this experiment's outcome expressing a significant effect of NP levels on total yield of okra. Mitra (1990) forwarded contradictory statements to the findings of this research, expressing insignificant impact of NPK levels on the total yield of okra. Iyagba et al. [18] expressing a significant influence of NPK on the total yield of okra was found to have results which are at par with result of this experiment. Rahman et al. [19] reported results which are in line to the finding of this experiment, where total yield was significantly influenced by different NPK levels.

Marketable Yield

Though the marketable yield was not found to be influenced by PK fertilizer application, sowing date was observed to have a significant effect on the marketable yield of okra fruits (Table 3) and (Table 8). The highest marketable yield (99.03%) was recorded from early-September sowing date followed by mid-August sowing date recording a value of 95.26% and the least marketable yield (89.36%) was recorded from late-July date of sowing (Table 3). The lowest value of the marketable yield obtained from late-July sowing date was due to the insect attack predominantly aphids which were favoured by the warmer climate prevailed during flowering and fruiting resulting in to blemished pods.

Treatment	NF/P	IFW (g)	TY (t/ha)	MY (%)	DW (%)
Sowing dates					
Late-July	33.21	8.29	12.09	89.36	15.26
Mid-August	34.97	7.35	11.3	95.26	14,2
Early-September	28.13	6.9	8.64	99.03	13.62
$LSD_{0.05}$	3.56	0.58	1.35	2.69	0.41
PK fertilizer rates (Kg/ha)					
0 (Control)	25.04	7.5	8.39	94.1	14.73
125	31.81	7.18	10	93.39	14.08
150	34.18	7.48	11.37	95.87	14.01
175	33.54	7.39	10.99	94.99	14.47
200	35.95	8	12.6	94.4	14.41
$LSD_{0.05}$	4,59	NS	1.75	NS	NS

Table 3: Yield and yield based parameters affected by sowing date and PK fertilizer rates.

Pod Dry Weight

Unlike the effect of PK fertilizer application, the sowing dates resulted in to the production of okra pods whose dry weights are significantly different. The significant variation was observed upon comparing all the three sowing dates among each other. The highest dry weight (15.26%) was recorded from late-July sowing date followed by mid-August sowing date with value 14.2% whereas the lowest dry weight (13.62%) was obtained from sowing date held in early-September (Table 3). The investigation carried out by Dilruba et al. [33] and Yadav and Dhankhar [38] reported that maximum dry weight of okra was observed from 06th April sowing as compared to those sown in the month of March which was found to be in line with the outcome of this experiment and the increased dry matter could be probably due more exposure of plants to warmer periods. Thakur et al. [28] and Omottoso et al. [29] expressing insignificant impact of various NPK levels on dry weight where it tends to be in line with outcome of this experiment.

CONCLUSION

Results of the present study revealed that all the parameters considered in this study except the number of leaves and numbers of branches were found to be significantly influenced by the sowing date differences. Out of the three dates of sowings, Late-July sowing date led to the production of the highest total yield (12.09 t/ha). A combined application of the Phosphorous and potassium fertilizer led to significant effects on all the growth traits and also on the total yield of okra pods. Yield was increased by 50.18% by applying the combined PK fertilizer at a rate of 200 Kg/ha. Thus, according to the current study, the combined phosphorous and potassium fertilizer should be applied at a rate of 200 Kg/ha in the ratio of 3:2 to maximize okra pod production.

AUTHORS' CONTRIBUTION

Bahran Knfe Yakob: Conducted the field experiment, analyzed the data and wrote the manuscript.

Brhan Khiar Saleh: Editing of the manuscript.

CONFLICT OF INTEREST

We would like to declare that there is no any conflict of interest.

REFERENCES

1. Rao SR, Nongsiang RH, Devi MK (2019) Okra—an important crop of India. The NEHU Journal 17(1&2): 126-131.
2. Dantas TL, Alonso Buriti FC, Florentino ER (2021) Okra (Abelmoschus esculentus L.) as a Potential Functional Food Source of Mucilage and Bioactive Compounds with Technological Applications and Health Benefits. Plants 10(8): 1-14.
3. Zeb S, Ali QS, Jamail E, Ahmad N, Sajid M, et al. (2021) Effect of sowing dates on the yield and seed production of Okra cultivars in Mansehra. Pure and Applied Biology 4(3): 313-317.
4. Nkongho RN, Efouba-Mbong JT, Ndam LM, Ketchem GA, Etchu-Takang EG, et al. (2022) Seed production system and adaptability of okra (Abelmoschus esculentus L.) cultivars in Buea, Cameroon. PLoS ONE 17(12): e0278771.
5. Budania YK, Dahiya HS (2018) Impact of Microclimate Modification on Okra Cultivation: A Global Review. Int J Curr Microbiol Appl Sci 7(10): 426-438.
6. Rawat N, Karnatak AK, Srivastava RM (2020) Population dynamics of major sucking insect pests of Okra in agro-climatic condition of Pantnagar. Journal of Entomology and Zoology Studies 8(1): 540-545.
7. Uwiringiyimana T, Habimana S, Umuhozariho MG, Bigirimana VP, Uwamahoro F, et al. (2024) Review on Okra (Abelmoschus esculentus (L.) Moench) Production, Nutrition and Health Benefits. Rwanda Journal of Agricultural Sciences 3(1): 71-87.
8. Bose TK (2003) Okra. In: Bose TK, et al. Tropical horticulture. (7th edn), Naya Prokash Publishers, Calcutta, India. 2: 215-246
9. Uka UN, Chukwuka KS, Iwuagwu M (2013) Relative effect of organic and inorganic fertilizers on the growth of okra [Abelmoschus Esculentus (L) Moench]. Journal of Agricultural Sciences 58(3): 159-166
10. Nadkarni KM (1972) Indian materia medica. Nadkarni publishing co., Bombay.
11. Tiwari KN (2009) World production of okra in tropical regions.
12. Ministry of Agriculture (2012) Statistical report, Asmara, Eritrea.
13. Ministry of Agriculture (2015) Statistical report, Asmara, Eritrea.
14. Mike J (2010) Productivity of Okra at varying sowing dates. Journal of Applied Biosciences 32: 2015–2019.
15. Bake ID, Singh BK, Singh AK, Moharana DP, Maurya AK (2017) Impact of planting distances and sowing dates on yield attributing traits of okra [Abelmoschus esculentus (L.) Moench] cv. Kashi Pragati. International Journal of Current Microbiology and Applied Sciences 6(7): 4112-4125.
16. Reddy TY, Reddi GHS (2014) Principles of Agronomy. Kalyani Publishers, Ludhiana, India, pp. 185.
17. Shiyab S, Al-Qarallah B, Akash M, Statieh M, Ayad J, e al. (2014) Response of okra (Abelmoschus esculentus (L.) to different levels of hoaglands solution. Life Science Journal 11(10): 1080.
18. Iyagba1 AG, Onuegbu BA, Ibe AE (2013) Growth and yield response of okra to NPK fertilizer rates and weed interference. International Research Journal of Agricultural Science and Soil Science 3(9): 328-335.

19. Rahman M, Akter F (2012) Effect of NPK on growth, yield and yield attributes of okra. Bangladesh J Bot 41(2): 131-134.

20. Havlin JL, Beaton JD, Tisdale SL, Nelson WL (2005) Soil fertility and fertilizers (7th edn), Pearson Prentice Hall Publishers, New Jersy, USA.

21. Amjad M, Anjum MA, Anjum, Hussain S (2001) Effect of different sowing dates and various doses of fertilizers on the juvenility and the productivity of Okra. Pak J Agri Sci 38: 1-2.

22. Bhende S, Deshmukh HK, Nimbolkar PK Dewangan RK, Nagone AH (2015) Effect of phosphorous and potassium on quality attributes of okra cv. 'Arka Anamika'. International journal of environmental sciences 6(2): 225-231.

23. Sinha P, Agrawal DK, Prasad D (2005) Predictive management of powdery mildew diseases. In: Prasad D. Crop management strategies. Daya publishing house, Delhi, India, pp: 213-221.

24. Kemal-Ali (1997) Economic treshhold for pea aphid. Pest management Journal of Ethiopia 1(1): 63-68.

25. Naheed Z, Ayyaz A, Rehman A, Khan NA, Qayyum S (2013) Agronomic traits of Okra cultivars under agro-climatic conditions of Baffa (KPK), Pakistan. J Mater Environ Sci 4(5): 655-662.

26. Chattopadhyay A, Dutta S, Bhattacharya I, Karmakar K, Hazra P (2011) Technology for vegetable crop production. Published by All India Coordinated Research Project on Vegetable crops, Directorate of Research, Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia, West Bengal, India. pp: 680.

27. Tandel BM, Prabhu-Nayaka, Shah KA (2017) Yield of okra as influenced by the different sowing dates and plant spacing. International Journal of Chemical Studies 5(5): 91-93

28. Thakur MR, Arora SK, Kabir J (2003) Okra. In TK Bose, MG Som, J Kabri, TK Maity and VA Parthasanarathy (3rd edn), Vegetable crops Vol (3). Naya-udyog publishers, Kolkata, India.

29. Omottoso SO, Shittu OS (2007) Effect of NPK rates on growth, yield and yield attributes of Okra. Research Journal of Agronomy 1(2): 84-87.

30. Gloria PM, Ibrahim Iro I, Zwalnan DN, Jameela A, Henry UI (2017) Effect of different levels of npk fertilizer on the growth and yield of okra (Abelmoschus Esculentus L.) International Journal of Advanced Academic Research | Sciences, Technology & Engineering 3(1): 1-8.

31. Olaniyi JO, Akanbi WB, Olaniran OA, Ilupeju OT (2010) The effect of organo-mineral and inorganic fertilizers on the growth, fruit yield, quality and chemical compositions of okra. J Anim Plant Sci 9(1): 1135-1140.

32. Ashoks SS, Shekhargouda M, Badanur VP (2002) Influence of dates of sowing, spacing and levels of NPK on yield attributes and seed yield in Okra. Karnafaka. J Agric Sci 15(2): 267-274

33. Dilruba S, Hasanuzzaman M, Karim R, Nahar K (2009) Yield Response of Okra to Different Sowing Time and Application of Growth Hormones. Journal of Horticultural Science & Ornamental Plants 1(1): 10-14.

34. Firoz ZA (2009) Impact of phosphorous and Potassium on the growth, yield of Okra. Bangladesh J Agril Res 34(4): 713-722.

35. Ahmed N, Tullock-Reid LT (1986) The combined effect of NPK fertilizers for the increase of yield of Okra. Agronomy Journal 60: 353-356.

36. Philip CB, Sajo AA, Futuless KN (2010) Effect of spacing and NPK fertilizer on the yield and yield components of okra (Abelmoschus esculentus (L. Moench.) in Mubi, Adamawa State, Nigeria. Journal of Agronomy 9: 131-134.

37. Hossain MD, Salam MA, Islam MS, Masud MAT (2001) Yield and quality of okra seeds as influenced by times of sowing. Bangladesh Journal of Seed Science Technology 3(1-2): 83-87.

38. Yadav SK, Dhankar BS (2001) Seed production and quality of okra (Abelmoschus esculentus (L.) Moench) as affected by sowing time and position of fruit on plant. Seed Res 29(1): 47-51.