Revised Article

www.ekinjournal.com

Ekin International biannual peer-reviewed journal

Ekin
Journal of Crop Breeding and Genetics

10(2):111-118, 2024

Performance of Different Okra Varieties for Fruit Yield and Resistance Against Yellow Vein Mosaic Virus (YVMV) and Okra Enation Leaf Curl Virus (OELCV) under Climate Change

Kuldeep KUMAR[1] VIKRAM[1] Rakesh KUMAR[1] Makhan MAJOKA[1] Kishor Chand KUMHAR[1] Rajesh Kumar ARYA[2*]

[1] Department of Vegetable Science, CCS Haryana Agricultural University, Hisar-125004, India
[2] Department of Genetics and Plant Breeding, CCS Haryana Agricultural University, Hisar-125004, India

[*] Corresponding author e-mail: rakarayogi@gmail.com

Citation:
Kumar K., Vikram., Kumar R., Majoka M., Kumhar KC., Arya RK., 2024. Performance of Different Okra Varieties for Fruit Yield and Resistance Against YVMV and OELCV under Climate Change. Ekin J. 10(2):111-118.

Received: 15.04.2024 ***Accepted: 05.05.2024*** ***Published Online: 30.07.2024*** ***Printed: 31.07.2024***

ABSTRACT

A field experiment was carried out to evaluate the performance of 12 new entries of okra during 2019 and 2020 at the Research Farm of Vegetable Science, CCS HAU, Hisar. In the present evaluation, during 2019, out of 12 tested entries of okra, 19/OKYVRES-5 recorded the maximum fruit yield (116.4 q/ha) with no incidence of YVMV (0.0%) and f OELCV (0.0%), whereas the minimum yield (77.2 q/ha) with higher percentage of YVMV (13.4%) and OELCV (22.1%) was found in 19/OKYVRES-7. Likewise, during 2020, twelve entries of Okra were again tested, the maximum fruit yield (113.3 q/ha) with minimum incidence of YVMV (0.2%) and no incidence of OELCV (0.0%) was recorded in 9/OKYVRES-5, whereas the minimum yield (72.4 q/ha) with maximum percentage of YVMV (19.6%) and OELCV (25.4%) was found in 19/OKYVRES-7. It may concluded that the newly developed variety 19/OKYVRES-5 of okra has average fruit weight 114.85 q/ha and also reflected resistant against YVMV and OELCV, therefore, may recommended for commercial cultivation after testing it over the locations and years.

Keywords: Okra, cultivars, climate change, growth, fruit yield, YVMV, OELCV

Introduction

Today, the entire world is worried about the impact of climate change on plants including the vegetable crops. In the last 200 years, due to industrial revolution the climatic factor is changing very fast that's why some of crops are facing problem of adaption in changed climate. (Arya et al., 2014). The effect of climate on vegetables production is associated to the variabilities in local climatic factors rather than in international climate patterns. The average temperature of earth crust has increased by 1 degree F in just over the last century (Arya et al., 2020). Consequently, researchers consider any assessment has to be individually considering each location. Therefore, to face the challenges of climate change, concerted efforts are needed to evaluate, the released varieties of vegetable crops against the stressed environment.

Okra (*Abelmoschus esculentus* L. Moench) is one of the most important export oriented vegetable crop of India (Desh Raj et al., 2013 and 2014). It ranks first in vegetable production with 6095 thousand tonnes (Anonymous, 2018a). In India, it is commonly grown in the states of Maharashtra, Gujarat, Karnataka, TN, Punjab, Haryana, UP, Bihar, WB and Odisha (Swarup, 2006). In Haryana, it is grown for its tender immature green fruits which are cooked in curry as well as in soups. The roots and stem are used for clearing cane juice during preparation of jaggary. Its dry seeds contain 13-22% edible oil and 20-24% protein. Its seed cake is also used as animal feed. The dry fruit

shell and stem contain crude fibers which are used in manufacture of paper and cardboard. Okra has certain medicinal values like curing ulcers and relief from haemorrhoids. It is beneficial to people suffering from leucorrhoea and general weakness. The high iodine content in its fruits is considered useful to control goiter (Thamburaj and Singh, 2018). It is very important source of protein, carbohydrates, vitamin A, Vitamin C, Ca, K, Mg, and several other mineral elements, which generally found missing in our daily food. In addition to dietary benefits, okra is also serves a good medicine in case of peptic ulcer problems as it is one of the cheap source of plasma replacement in our body fluid system (Makinde et al., 2022).

For profitable commercial production of any vegetable crop, the high yielding and disease resistant variety is the first basic requirement of vegetable growing farmers (Majoka et al., 2021; Oo et al., 2022). Therefore, to achieve the maximum yield production for a variety identify the specific sowing duration under a set of specific climatic conditions. The assessment of available vegetable crop varieties under different environments provides valuable information to the scientist for further improvement in yield (Vu et al., 2017; Oo et al., 2023). In India, okra cultivation is influenced by several abiotic and biotic agents and significant fruit yield reduction has been noticed (Sanwal et al., 2016). These constraints further increase with increasing cropping intensity of very few HYV. Under this critical situation, fruit yield and quality can be improved by addressing the key factors responsible for yield losses, i.e. viral diseases (Sanwal et al., 2014). Among the viruses affecting the okra, YVMV and OELCV causes big losses in okra cultivation. Therefore, in the present investigation, twelve newly developed entries were evaluated for yield and its contributing triats and against YVMV and OELCV diseases.

Materials and Methods

A field experiment was planned to evaluate the performance of twelve okra new entries during seasons of 2019 and 2020 at the Research Farm of Vegetable Science, CCS Haryana Agricultural University, Hisar, India in RBD with three replications. The experimental location in Hisar is situated at the latitude of 29º 10' N, the longitude of 75º46' E and at an altitude of 215.2 m above mean sea level on South-Western edge of the Rajasthan state and at a remoteness of about 175 kilometers in West direction, New Delhi. This region is characterized as semi-arid climate along with hot and dry winds during summer and dry severe cold in winters which are common features of this region. The temperature in this area exhibit wide range from 44-48ºC in summer season and as low as up to freezing point accompanied with chill frost in the winter season (Majoka et al., 2021). Highest rainfall in this area is received during the months of July to September with showers in the month of January to late spring. In the present experiment, each entry was accommodated in plot size of 3.0 m x 2.7 m with spacing 60 cm x 45 cm and all the good cultural practices were followed to raise the okra crop (Anonymous, 2023). The observations were recorded on five competitive plants in each treatment for fruit length (cm), average fruit weight (g), fruit yield per plant (kg), YVMV (%) and OELCV (%). The data was subjected to the RBD statistical analysis as per procedure suggested by Panse and Sukhatme, 1985.

Results and Discussion

The analysis of variance (ANOVA) for number of fruits per plant, fruit length, average fruit weight (g), fruit yield (q/ha), YVMV (%) and OELCV (%) reflected the significant differences among the entries of okra under the present investigation.

Number of fruits per plant

The results of present investigation are presented in Table 1. Out of 12 tested entries of Okra, during 2019, maximum no. of fruits per plant 24.03 was recorded by 19/OKYVRES-5 which was at par with 19/OKYVRES-9 (20.62) and followed by 19/OKYVRES-13 (19.29), 19/OKYVRES-11 (16.91), 19/OKYVRES-2 (15.43). During 2020, maximum no. of fruits per plant 21.10 was recorded in 19/OKYVRES-5 followed by 19/OKYVRES-9 (17.45), 19/OKYVRES-13 (16.60), 19/OKYVRES-11 (13.80), 19/OKYVRES-2 (13.41). Based on the average of both the years, maximum no. of fruits per plant 22.57 was recorded in 19/OKYVRES-5 followed by 19/OKYVRES-9 (19.04), 19/OKYVRES-13 (17.95), 19/OKYVRES-11 (15.36) and 19/OKYVRES-2 (14.42). Similar findings were also reported by Batra and Singh. 2000; Rashid et al., 2002 and Malshe et al., 2016. While working on cowpea, Vu et al. (2019) also revealed the lot of variations in fruit yield and reported some promising genotypes.

Fruit length (cm)

The data presented in Table 1 revealed that out of 12 tested entries of Okra, during 2019, maximum fruit length 11.30 cm was recorded by 19/OKYVRES-8 which was at par with 19/OKYVRES-5 (11.00 cm) and followed by 19/OKYVRES-13 (10.40 cm), 19/OKYVRES-2 (10.00 cm), 19/OKYVRES-6 (9.80 cm). During 2020, maximum fruit length 11.10 cm was recorded in 19/OKYVRES-8 which was at par with

19/OKYVRES-5 (10.70 cm), 19/OKYVRES-13 (10.60 cm) and followed by 19/OKYVRES-2 (9.80 cm), 19/OKYVRES-7 (9.50 cm) and 19/OKYVRES-9 (9.50 cm). Based on the average of both the years, maximum fruit length 11.20 cm was recorded in 19/OKYVRES-8 followed by 19/OKYVRES-5 (10.80 cm), 19/OKYVRES-13 (10.55 cm), 19/OKYVRES-2 (9.90 cm), and 19/OKYVRES-6 (9.45 cm). Similar findings were also reported by Batra and Singh. 2000; Rashid et al., 2002 and Malshe et al., 2016.

Average fruit weight (g)

The data on average fruit weight of okra presented in Table 2 shows that during 2019, maximum average fruit weight 12.40 g was recorded in 19/OKYVRES-5 which was at par with 19/OKYVRES-7 (12.10 g) and followed by 19/OKYVRES-13 (11.10 g), 19/OKYVRES-1(10.90 g) and 19/OKYVRES-2 (10.70 g). During 2020, maximum average fruit weight 11.80 g was recorded in 19/OKYVRES-5 which was at par with 19/OKYVRES-13 (11.50 g), 19/OKYVRES-7 (11.40 g), 19/OKYVRES-2 (10.70 g) and 19/OKYVRES-9 (10.70 g). Based on the average of both the years, maximum fruit length 12.10 g was recorded in 19/OKYVRES-5 followed by 19/OKYVRES-7 (11.75 g), 19/OKYVRES-13 (11.30 g), and 19/OKYVRES-2 (10.70 g). Above finding were supported by Abdul et al., 2004 and Malshe et al., 2016.

Fruit yield (q/ha)

Data on fruit yield of okra is depicted in Table 2 for the year 2019 and 2020. Out of 12 tested entries of Okra, during 2019, maximum average fruit yield 116.40 q/ha was recorded in 19/OKYVRES-5 followed by 19/OKYVRES-9 (108.00 q/ha), 19/OKYVRES-13 (107.20 q/ha), 19/OKYVRES-2 (102.20 q/ha) and 19/OKYVRES-11(101.20 q/ha). During 2020, maximum average fruit yield 113.30 q/ha was recorded in 19/OKYVRES-5 followed by 19/OKYVRES-9 (106.10 q/ha), 19/OKYVRES-13 (104.10 q/ha), 19/OKYVRES-11 (103.00 q/ha) and 19/OKYVRES-2 (100.30 q/ha). Based on the average of both the years, maximum average fruit yield 114.85 q/ha was recorded in 19/OKYVRES-5 followed by 19/OKYVRES-9 (107.05 q/ha), 19/OKYVRES-13 (105.65 q/ha), 19/OKYVRES-11 (102.10 q/ha) and 19/OKYVRES-2 (101.25 q/ha). Similar findings were also reported by Abdul et al., 2004 and Malshe et al., 2016. Singh et al., (2024) evaluated 10 hybrids of okra and reported that the hybrid Amanat was found to be best in term of fruit yield production.

YVMV (%)

The information in disease incidence is presented in Table 3 for year 2019 and 2020. During 2019, no incidence of YVMV was noticed in 19/OKYVRES-5 and very low incidence of YVMV was observed in 19/OKYVRES-13 (1.20%), 19/OKYVRES-2 (2.30%), 19/OKYVRES-11 (2.50%) and 19/OKYVRES-9 (3.20%). During 2020, lowest incidence (1.20%) of YVMV was observed in19/OKYVRES-5 followed by 19/OKYVRES-13 (2.70%), 19/OKYVRES-11 (3.40%), 19/OKYVRES-10 (5.90%) and 19/OKYVRES-2 (6.10%). Based on the average of both the years, lowest incidence (0.60%) of YVMV was observed in 19/OKYVRES-5 followed by 19/OKYVRES-13 (1.95%), 19/OKYVRES-11 (2.95%), 19/OKYVRES-2 (4.20%) and 19/OKYVRES-10 (5.35%). Above finding were supported by Singh et al., 2002; Zulfequar and Patil, 2004; Sanwal et al., 2014 and Malshe et al., 2016.

OELCV (%)

Out of 12 tested entries of Okra, during 2019, no incidence of OELCV was noticed in 19/OKYVRES-2, 19/OKYVRES-5, 19/OKYVRES-6, 19/OKYVRES-9, 19/OKYVRES-10 and 19/OKYVRES-13. In addition to this, low incidence (2.70%) of YVMV was observed in 19/OKYVRES-3 followed by 19/OKYVRES-11 (2.90%), and 19/OKYVRES-1 (3.50%). During 2020, zero incidence of OELCV was noticed in 19/OKYVRES-2, 19/OKYVRES-5, 19/OKYVRES-6, 19/OKYVRES-9, 19/OKYVRES-10 and 19/OKYVRES-13. In addition to this, low incidence 3.10% was seen in 19/OKYVRES-12 followed by 19/OKYVRES-3 (3.30%) and 19/OKYVRES-11 (3.40%). Based on the average of both the years, zero incidence of OELCV was noticed in 19/OKYVRES-2, 19/OKYVRES-5, 19/OKYVRES-6, 19/OKYVRES-9, 19/OKYVRES-10 and 19/OKYVRES-13. In addition to this, low incidence (3.0%) of YVMV was observed in 19/OKYVRES-3 followed by 19/OKYVRES-11 (3.15%), and 19/OKYVRES-1 (3.85%). Above finding were supported by Singh et al., 2002; Zulfequar and Patil, 2004; Sanwal et al., 2014.

Out of 12 tested entries of Okra, during 2019, the maximum fruit yield (116.40 q/ha) with no incidence of YVMV and OELCV was recorded in 19/OKYVRES-5, whereas the minimum yield (77.2 q/ha) with higher percentage of YVMV (24.7%) and OELCV (5.2%) was found in 19/OKYVRES-8. Likewise, during 2020, Twelve entries of Okra were tested, the maximum fruit yield (113.3 q/ha) with minimum incidence of YVMV (1.2%) and no incidence of OELCV was recorded in 19/OKYVRES-5, whereas the minimum yield (72.4 q/ha) with maximum percentage of YVMV (27.4%) and OELCV (6.8%) was found in 19/OKYVRES-8. However, maximum incidence of OELCV (22.1 and 25.4% resp.) was recorded in 19/OKYVRES-7 during both the years. Singh et al., (2024) evaluated 10 hybrids were Anmol, Aryushi, Super Sneha, Sonali-99,

Sharmili, Julie, Amanat, Karishma, Nandini-7080, Best Green-11 Prayagraj agro climatic conditions reported that the hybrid Amanat was found to be best in term of vegetative parameters, quality parameters, yield.

In India, Okra fruit yield loss is directly associated with viral disease, probably due to favorable tropical warm climatic conditions for the survival of whitefly vector. In addition to this, the overlapping and mixed cropping pattern favors the growth of whitefly vector. Therefore to overcome the yield losses in okra, development of new resistant varieties is the eco-friendly, economical and practical way (Sanwal et al., 2014 and 2016). Therefore, development of new variety 19/OKYVRES-5 with maximum average fruit yield 114.85 q/ha accompanied with resistance against YVMV and OELCV may recommended for commercial cultivation after testing it over the locations and years. The disease incidence of YVMV and OELCV was found negatively correlated with yield during both the seasons (Fig. 3a-d). As the diseased plant photosynthetic capacity is decreased which ultimately leads to reduction in yield. During second year, rainfall was less and almost season was dry, which fevers the growth of white flies - a vector responsible for transmission of viral diseases. Only the resistance genotype e.g. 19/OKYVRES-5 performed better results. Therefore, it can be utilized to develop the resistant genotypes of okra for commercial cultivation in era of climate change.

The increase in okra yield, under Hisar climatic conditions can be credited to several environmental factors and the characteristics of the okra cultivars themselves. Firstly, Hisar climatic is characterized by warm temperatures, low rains, and fertile soils that is optimum for okra growth and yield. The newly developed varieties may have improved resistance against disease, tolerance to climatic up and downs, and leads to healthier crop growth and increased yield.

Conclusion

It may concluded that the newly developed variety 19/OKYVRES-5 of okra has average fruit yield 114.85 q/ha and also resistant against YVMV and OELCV diseases, therefore, may recommended for commercial cultivation after testing it over the locations and years. The disease incidence of YVMV and OELCV was found negatively correlated with yield. Therefore, there is an urgent to develop the resistant genotypes of okra for commercial cultivation in era of climate change.

Acknowledgments

Authors are highly thankful to Head, Department of Vegetable Sciences for all kind of help, including necessary facilities and valuable suggestions for successful completion of present study.

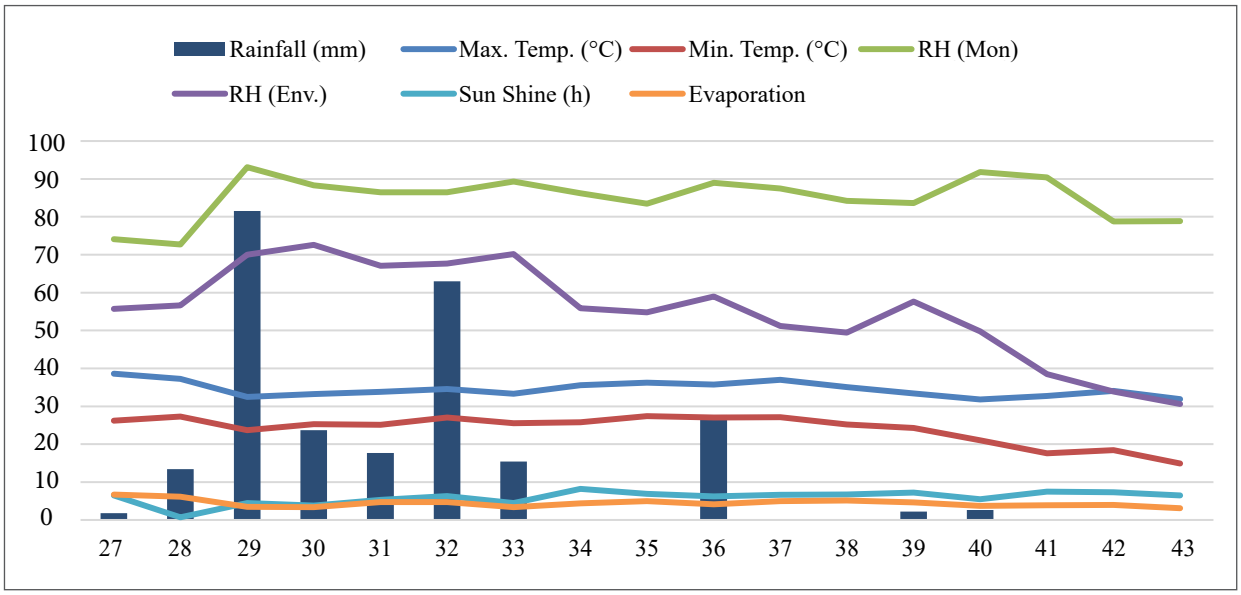

Figure 1. Weather parameters recorded during season 2019.

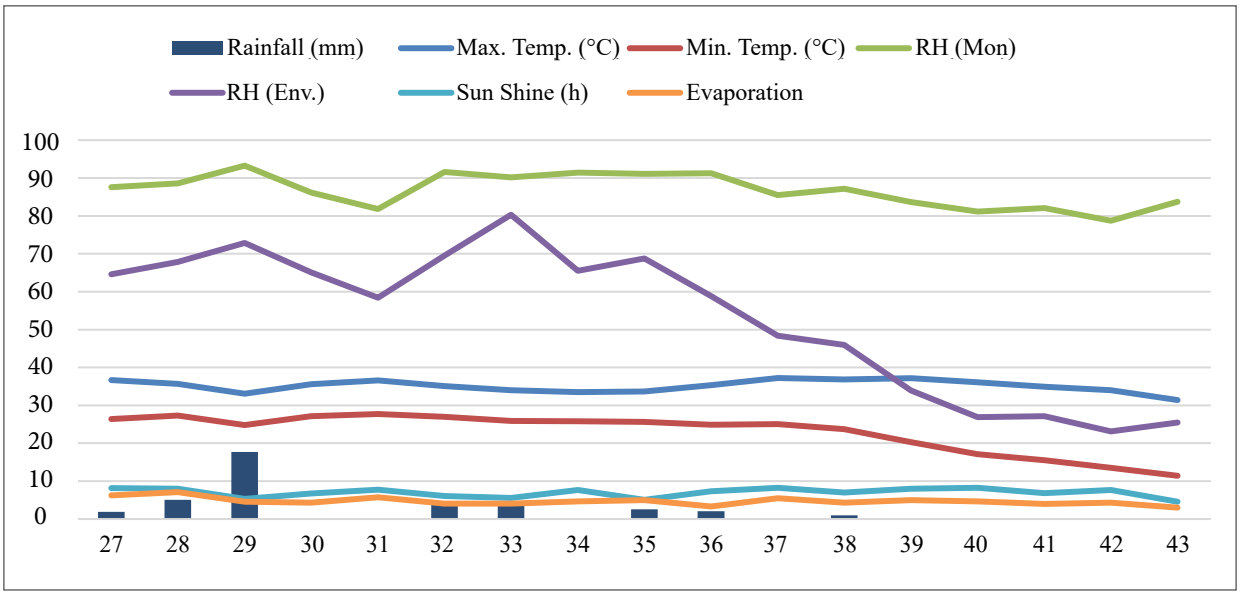

Figure 2. Weather parameters recorded during season 2020.

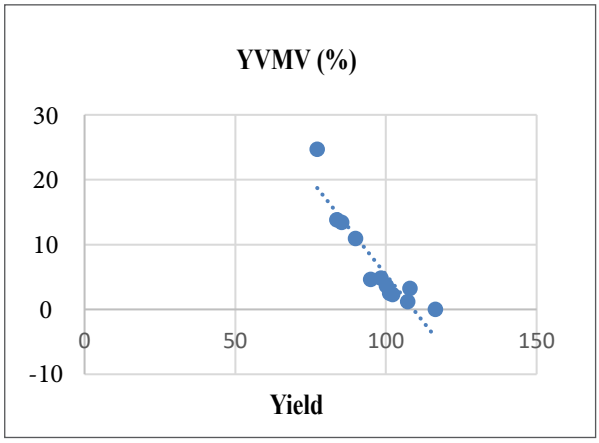

Figure 3a. Correlation between yield and YVMV (%) during 2019.

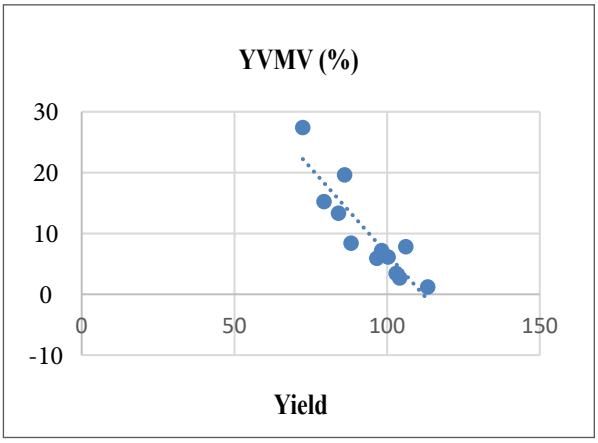

Figure 3b. Correlation between yield and YVMV (%) during 2020.

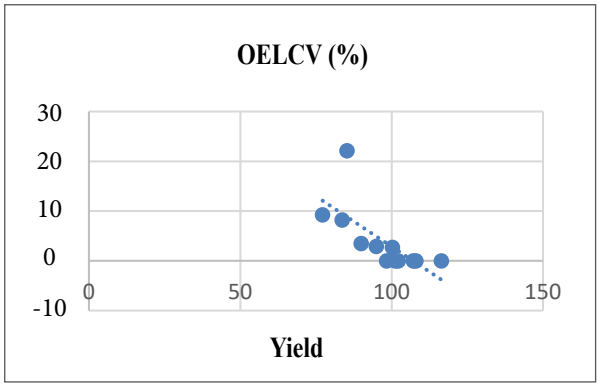

Figure 3c. Correlation between yield and OELCV (%) during 2019.

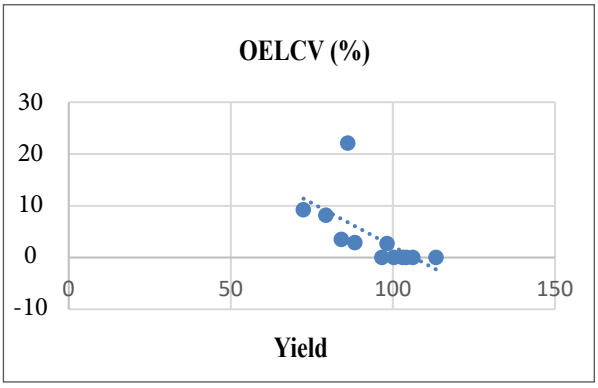

Figure 3d. Correlation between yield and OELCV (%) during 2020

Table 1. Performance of okra entries for no. of fruits per plant and fruit length (cm) at Hisar.

Serial Number	Entries	No. of Fruits/plant			Fruit Length (cm)		
		2019	2020	Mean	2019	2020	Mean
1	19/OKYVRES-1	14.12	10.32	12.22	9.60	9.10	9.35
2	19/OKYVRES-2	15.43	13.41	14.42	10.00	9.80	9.90
3	19/OKYVRES-3	14.61	11.24	12.93	8.80	9.30	9.05
4	19/OKYVRES-5	24.03	21.10	22.57	11.00	10.70	10.80
5	19/OKYVRES-6	13.89	10.14	12.01	9.80	9.10	9.45
6	19/OKYVRES-7	8.85	8.10	8.48	8.40	9.50	8.95
7	19/OKYVRES-8	11.86	10.50	11.18	11.30	11.10	11.20
8	19/OKYVRES-9	20.62	17.45	19.04	9.00	9.50	9.25
9	19/OKYVRES-10	14.35	10.92	12.63	7.90	7.70	7.80
10	19/OKYVRES-11	16.91	13.80	15.36	8.50	9.00	8.75
11	19/OKYVRES-12	12.96	13.10	13.03	7.70	9.10	8.40
12	19/OKYVRES-13	19.29	16.60	17.95	10.40	10.60	10.55
	Mean	**15.58**	**13.06**	**14.32**	**9.37**	**9.54**	**9.45**
	Range	8.85 - 24.03	8.1 - 21.10	8.48 -22.57	7.70 - 11.30	7.70 - 11.10	7.80 - 11.20
	CD (5%)	2.75	2.29	2.52	0.60	1.00	0.80

Table 2. Performance of okra entries for average fruit weight (g) and fruit yield (q/ha) at Hisar.

Serial Number	Entries	Average fruit weight (g)			Fruit yield (q/ha)		
		2019	2020	Mean	2019	2020	Mean
1	19/OKYVRES-1	10.90	9.60	10.25	89.90	84.10	87.00
2	19/OKYVRES-2	10.70	10.70	10.70	102.20	100.30	101.25
3	19/OKYVRES-3	10.10	10.10	10.10	100.20	98.20	99.20
4	19/OKYVRES-5	12.40	11.80	12.10	116.40	113.30	114.85
5	19/OKYVRES-6	10.30	9.80	10.05	94.90	88.20	91.55
6	19/OKYVRES-7	12.10	11.40	11.75	85.30	86.10	85.70
7	19/OKYVRES-8	10.00	10.50	10.25	77.20	72.40	74.80
8	19/OKYVRES-9	10.50	10.70	10.60	108.00	106.10	107.05
9	19/OKYVRES-10	8.90	8.50	8.70	98.30	96.60	97.45
10	19/OKYVRES-11	9.90	10.10	10.00	101.20	103.00	102.10
11	19/OKYVRES-12	9.60	9.60	9.60	83.70	79.30	81.50
12	19/OKYVRES-13	11.10	11.50	11.30	107.20	104.10	105.65
	Mean	**10.54**	**10.36**	**10.45**	**97.04**	**94.31**	**95.68**
	Range	8.90- 12.4	8.50- 11.8	8.70-12.10	77.2- 116.4	72.4- 110.3	74.8- 113.35
	CD (5%)	1.20	1.60	1.40	7.30	6.70	7.00

Table 3. Performance of okra entries for YVMV (%) and OELCV (%) at Hisar.

Serial Number	Entries	YVMV (%)			OELCV (%)		
		2019	2020	Mean	2019	2020	Mean
1	19/OKYVRES-1	10.90	13.30	12.10	3.50	4.20	3.85
2	19/OKYVRES-2	2.30	6.10	4.20	0.00	0.00	0.00
3	19/OKYVRES-3	3.60	7.20	5.40	2.70	3.30	3.00
4	19/OKYVRES-5	0.00	1.20	0.60	0.00	0.00	0.00
5	19/OKYVRES-6	4.60	8.40	6.50	2.90	3.40	3.15
6	19/OKYVRES-7	13.40	19.60	16.50	22.10	25.40	23.75
7	19/OKYVRES-8	24.70	27.40	26.05	9.20	10.80	10.00
8	19/OKYVRES-9	3.20	7.80	5.50	0.00	0.00	0.00
9	19/OKYVRES-10	4.80	5.90	5.35	0.00	0.00	0.00
10	19/OKYVRES-11	2.50	3.40	2.95	0.00	0.00	0.00
11	19/OKYVRES-12	13.80	15.20	14.50	8.20	3.10	5.65
12	19/OKYVRES-13	1.20	2.70	1.95	0.00	0.00	0.00
	Mean	**7.08**	**9.85**	**8.47**	**4.05**	**4.18**	**4.12**
	Range	0.00 -24.70	1.20 -27.40	1.95 -26.05	0.00 -22.10	0.00 -25.40	0.00 -23.75

References

Abdul NM, Joseph JK and Karuppaiyan R, (2004). Evaluation of okra germplasm for fruit yield, quality and field resistance to yellow vein mosaic virus, Indian Journal of Plant Genetic Resources, 17(3):241-244.

Afroza B, Wani KP, Khan SH, Jabeen N, Hussain K, Mufti S and Amit A, (2010). Various technological interventions to meet vegetable production challenges in view of climatic change. Asian Journal of Horticulture, 5(2):523-529.

Anonymous, (2018). Horticulture statistics at a glance. Horticulture Statistics Division, Ministry of Agriculture and Farmers' Welfare, Government of India, New Delhi, 10 p.

Anonymous, (2023). Package and practices for cultivation of vegetables. CCS Haryana Agriculture University, Hisar, 1p.

Arya RK, Dahiya GS, Kumar R, Sutaliya JM, Vandana and Kumar P, (2020). Effect of heat stress on the elite genotypes of faba bean under semi-arid conditions. Forage Res., 46(3):236-240. http:// forageresearch.in

Arya RK, Singh MK, Yadav AK, Kumar A and Kumar S, (2014). Advances in pearl millet to mitigate adverse environment conditions emerged due to global warming. Forage Res., 40(2):57-70.

Batra SK and Singh J, (2000). Screening of okra varieties to yellow vein mosaic virus under field conditions. Vegetable Science, 27:192-193.

Desh Raj, Dahiya OS, Yadav AK, Arya RK and Kumar K, (2014). Effect of natural ageing on biochemical changes in relation to seed viability in okra (*Abelmoschus esculentus*). Indian Journal of Agril. Sciences. 84(2):280–286.

Desh Raj, Dahiya OS, Arya RK, Yadav AK and Kumar K, (2013). Improvement in germination characteristics in artificially aged seeds of okra (*Abelmoschus esculentus*) by osmoconditioning. Indian Journal of Agril. Sciences. 83(7):699-702.

Majoka M, Panghal VPS, and Duhan DS, (2021). Effect of nipping and plant spacing on seed production of cowpea in Haryana condition. Forage Res., 46 (4):343-347. http:// forageresearch.in

Makinde AI, Oyekale KO and Daramola DS, (2022).

Growth and yield of okra as influenced by fertilizer application under different cropping system. Agricultural Socio-Economics J. 22:29-36.

Malshe KV, Shinde BD, Desai BG and Palshetkar MG, (2016). Performance of different varieties of okra (*Abelmoschus esculentus*) in relation to yellow vein mosaic disease under north Konkan conditions. IJABR, 6(4):533-535.

Oo PP. Panchta R, Nimbal S, Singh DP, Kharor N, Arya S and Sonu L, (2022). Morphological characterization of leaf, flower, pod and seed traits of cowpea [*Vigna unguiculata* (L.) Walp] genotypes. Forage Res., 48:50-56.

Oo PP. Panchta R, Nimbal S, Kharor N, Arya S, Arya RK and Sonu L, (2023). Variability, character association and genetic divergence studies in cowpea [*Vigna unguiculata* (L.) Walp] genotypes. Range Management and Agroforestry 44(2):288-297.

Panse VG and Sukhatme PV, (1985). Statistical methods for agricultural workers. Indian Council of Agricultural Research, New Delhi., pp. 87-89.

Rashid MH, Yasmin L, Kibria MG, Mollk AKMSR and Monowar HSM, (2002). Screening of okra germplasm for resistance to yellow vein mosaic virus under field conditions. Plant Pathology J., 1:61-62.

Sanwal S, Venkataravanappa V and Singh B, (2016). Resistance to bhendi yellow vein mosaic disease: A review. The Indian Journal of Agricultural Sciences, 86(7):835-843. DOI:10.56093/ijas.v86i7.59721

Sanwal SK, Singh M, Singh B and Naik PS, (2014). Resistance to yellow vein mosaic virus and okra enation leaf cural virus: Challenges and future strategies. Current Science, 106(11):1470-1471.

Singh AK, Sanger RBS and Gupta CR, (2002). Performance of different varieties of okra to yellow vein mosaic virus under field conditions of Chhattishgarh. Progressive Horticulture, 34:113-116.

Singh AK, Bahadur V and Samir E Topno (2024). Evaluation of okra (*Abelmoschus esculentus*) hybrids under Prayagraj agro climatic conditions. International Journal of Advanced Biochemistry Research 2024; 8(5):477-479.

Swarup, V, (2006). Vegetable science and technology in India. Kalyani Publishers, Ludhiana., 587p.

Thamburaj S and Singh N, (2018). Textbook of vegetables, tuber-crops and spices. Indian Council of Agricultural Research, New Delhi. 230p.

Vu Nguyen Ngoc, Arya RK, Panchta R and Tokas J, (2017). Studies on genetic divergence in cowpea (*Vigna unguiculata*) by using D^2 Statistics under semi-arid conditions. Forage Res., 43(3):197-201.

Zulfequar A and Patil MS, (2004). Incidence of yellow vein mosaic virus on different okra cultivars in Karnataka. Karnataka J. Agric. Sci., 17(3):615-616.