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Impact of weather variables on yield and yield attributes in Okra under different growing environments

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ABSTRACT

Okra variety Hisar Unnat was sown on eight different dates during March to July of 2008 and 2009. Results revealed that high seed yield was obtained in okra sown on 15th June, 25th June and 5th July Seeds per fruit, test weight and standard germination were also found superior during this period. Average relative humidity had significantly positive correlation with seed yield (r=0.76), number of seeds per fruit (r=0.72), test weight (r=0.79) and standard germination (r=0.79). Maximum, minimum and mean temperatures and evaporation expressed significantly negative association with above parameters. High seed yield of okra can be harvested, when maximum, minimum, and mean temperature remains around 33.5-36°C, 19.5-24°C, and 26.9-30°C, respectively with average relative humidity 65-75% and 4.1 -5.7 mm evaporation. Seed yield prediction would be more reliable when temperature, relative humidity and evaporation were taken together instead of individual weather variable in regression equation.

Key words: Weather parameters, okra, seed yield and quality

Okra is an important vegetable crop grown through out the country for its tender green fruits during spring-summer and rainy seasons. It is good source of carbohydrates, vitamin A, B, C and rich in protein, calcium, potassium and other minerals. The powder of roasted seeds is used as substitute for coffee in Turkey (Martin, 1982). Dry seeds of okra contain 18-20 % oil and 20-23 % crude protein (Berry *et al*., 1988). Okra requires long warm growing season for better plant growth and higher yield. Although it can grow fairly well in hottest summer but grows better in hot and humid climate. Crop plants grow best, where, minimum and maximum mean temperatures are 18^{0}C and 35^{0}C, respectively. High day temperature (42^{0}C) may cause dropping of flowers due to increase rate of respiration. The influence of season on growth and production of okra has been studied by Bisaria and Shamshery (1979). Increased vigour and high productivity were observed when the crop was grown in rainy season than summer season. The suitable environment for seed production is low precipitation, low relative humidity, and high light intensity with hot dry conditions during seed ripening. Increasing differences between day and night temperatures can reduces seed yield considerably. Now farmers are becoming more conscious about seed and realize that their crop productivity depends mainly on quality of seed they use for planting the crop. With the development of numerous varieties, it has become necessary to maintain steady supply of good, vigorous and quality seeds to farmers to enable them to get good production. Seed production technology of okra varies with cultivar and agro-climatic conditions. Therefore, the present investigation was, undertaken to ascertain suitable growing environment for seed production of okra variety Hisar Unnat.

MATERIALS AND METHODS

A research experiment with eight sowing dates viz. March, 5, 15 and 25, April, 4, June, 15 and 25, July, 5 and 15 during the crop season of year 2008 and 2009 was conducted at Vegetable Science Research Farm of CCS Haryana Agricultural University, Hisar on okra variety Hisar Unnat. The treatments were laid out in randomized block design with three replications at spacing of 45x30 cm in a plot size of 2.5x1.0 m^2. All recommended cultural practices were adopted to raise a healthy crop. Fully mature fruits were harvested for seed extraction. The data on number of seeds per fruit was recorded on fruits taken from different positions (lower, middle, and upper portion) of five plants selected randomly in each treatment and the same was used to measure the test weight (g) and standard germination. Standard germination test was conducted as per the rules suggested by ISTA (1996). Simultaneously weather data

Table 1: Mean performance of okra variety *Hisar Unnat* for seed parameters in different sowing dates

Date of sowing	Standard Germination (%)		Test weight (g)		Seeds per fruit		Seed yield (q/ha)	
	2008	2009	2008	2009	2008	2009	2008	2009
5th March	81.2	78.0	54.3	52.2	39.0	37.0	9.5	8.4
15th March	80.0	75.0	53.8	51.5	38.0	35.0	8.6	7.3
25th March	79.5	74.5	54.1	52.0	36.0	34.0	8.1	7.0
4th April	78.1	74.0	53.1	51.4	35.0	33.0	8.0	7.5
15th June	88.5	85.5	65.9	63.9	50.0	49.0	15.4	14.4
25th June	91.0	89.1	66.0	65.0	53.0	52.0	16.0	15.2
5th July	89.0	88.4	64.9	64.9	52.0	52.0	15.2	14.6
15th July	88.0	88.3	62.4	61.2	47.3	46.4	14.0	13.3
CD at 5 %	2.12	2.15	1.55	1.60	2.60	2.50	1.18	1.20

Table 2: Correlation coefficients of seed yield and its attributes with different weather parameters in okra

Sr No	Weather variables	Standard Germination 1	Test weight 2	Seeds per fruit 3	Seed yield 4
1	Temp (Max)	-0.91**	-0.83**	-0.80**	-0.83**
2	Temp (Min)	-0.69**	-0.56*	-0.61*	-0.60*
3	Temp (Mean)	-0.87**	-0.76**	-0.77**	-0.78**
4	AVP (M)	0.24	0.36	0.25	0.30
5	AVP (E)	0.33	0.39	0.29	0.34
6	RH (M)	0.89**	0.89**	0.84**	0.87**
7	RH (E)	0.59*	0.59*	0.51*	0.55*
8	RH (Mean)	0.79**	0.79**	0.72**	0.76**
9	BSSH	0.16	0.28	0.32	0.32
10	Evap	-0.91**	-0.85**	-0.82**	-0.84**
11	Rain fall	0.19	0.20	0.13	0.14

**, ** significant at P= 0.05 and P= 0.01 level, respectively*

Table 3: Regression equation between seed yield and weather variables

Sr No	Weather variables	Regression equation	R^2
1	Temp (Max)	$Y= -1.09_{Tmax} +50.92$	0.72
2	RH (Mean)	$Y= 0.24_{RHMean} - 2.83$	0.57
3	Evaporation	$Y= - 1.42_{Evap} + 20.33$	0.74
4	Multiple Regression	$Y= -0.81_{Tmax} + 0.13RH\ mean+2.36_{Evap+17.92}$	0.97

recorded at nearby agrometeorological observatory in the research farm of the university were taken into account for all the sowing dates of okra in both the years. Pearson correlation of the seed yield and its attributes was also calculated based upon pooled data of the sowing dates as well as effect of weather variables on yield and its attributes.

RESULTS AND DISCUSSION

The results of the experiment revealed that sowing dates have significant effect on seed yield and its attributes like number of seeds per fruit and test weight and standard germination. Maximum seed yield (16.0 and 15.2 qha^{-1}), number of seeds per fruit (53.0 and 52.0) and test weight (66.0 and 65.0g) were recorded seed crop sown on 15th June, 2008 and 2009, respectively (Table 1). Seeds crop sown on 25th June and 5th July in indicated no significant difference respect to above traits with 15th June sown crop in both the years. A significant decrease in seed yield, number of seeds per fruit and test weight was also noticed in crops sown before 15th June and 5th July onward. Standard germination was also expressed similar trend as seed yield and its attributes. It designates that okra crop should be sown between 15th June to

5th July (mid June to first week of July) to get maximum seed yield with high germination. Availability of favorable environmental conditions for normal crop growth and seed formation and development might be the reason for more number of seeds per fruit, test weight and seed yield. The low seed yield, test weight and less number of seeds per fruit might be due to prevailing high and comparatively low temperature, respectively at seed development stage of the crop in seed crop sown before 15th June and 5th July onward, which might have affected the formation of seed. Grewal *et al.* (1974), Yadav *et al.* (2001) and Dhankhar *et al.* (2010) also observed similar trend for seed yield and its components at high or low temperature conditions during seed formation and development stage, which affects the quality of seed.

Among weather parameters, only relative humidity (%) had significantly positive correlation with seed yield (0.76*) and its attributes *viz.* number of seeds per fruit (0.72**) and test weight (0.79**) and standard germination (0.79**). Maximum, minimum and mean temperatures significantly negative association with seed yield (0.83**), number of seed per fruit (-0.80**), test weight (-0.83**) and standard germination (-0.91**). Evapo-transpiration also expressed significantly negative association with seed yield(0.84**), number of seed per fruit (-0.82**), test weight (-0.85**) and standard germination (-0.91**). Bright sun shine hours and actual vapour pressure exhibited no significant positive relationship with these parameters. This indicates that increase in temperatures and evapo-transpiration will reduce the seed yield, however, increase in relative humidity will increase yield of seed. Therefore, according to present study, high seed yield of okra can be harvested, when maximum, minimum, and mean temperature remains around 33.5-36°C, 19.5-24°C, and 26.9-30°C, respectively with average relative humidity 65-75% and 4.1 -5.7 mm evaporation (Table 2).

Weather parameters exhibiting strong significant correlation with seed yield have been considered for developing regression equation for seed yield prediction (Table 3) by taking weather variables as independent and seed yield as dependent variables. The coefficient of determination (R^2) of temperature, evaporation and relative humidity was 0.72, 0.74 and 0.57 percent. Thus, it indicated that seed yield up to 72, 74 and 57 per cent may be predicted through air temperature, evaporation and relative humidity, respectively in okra under Hisar Agroclimatic conditions. Multiple regression equation for prediction of seed yield using maximum, minimum and average temperatures, average relative humidity and evapotranspiration together explained 97 per cent variation in seed yield. Similar trend was reported by Singh *et al.* (2009).

CONCLUSION

It may be concluded here that maximum seed yield of okra can be obtained under the thermal regime of maximum, minimum and mean temperature around 33.5-36.0°C, 19.5-24.0°C and 26.9-30.0°C, respectively with 65-75 per cent relative humidity and 4.1-5.7 mm daily evaporation. The prediction of seed yield using regression equation will be more reliable when temperature, relative humidity and evaporation were taken together instead of individual weather variable.

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