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Growth and Fruit Yield of Okra as Influenced by Different Growing Environment

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Abstract **– A field experiment was conducted on okra crop during summer season 2009 at Anand to known the effect of weather on growth and fruit yield of okra. An experiment was laid down in split plot design with five dates of sowing *viz.* 15th February, 1st March, 15th March, 1st April and 15th April and four replications. The results revealed that the growth parameters like plant height (cm) and leaf area index (LAI) as well as fruit yield were found decreased significantly with delayed sowing. The average plant height and LAI were recorded maximum 36.5cm and 0.64 respectively in 15th Feb sown crop. The green fruit yield was also maximum 9524 kg/ha in the crop sown on 15th Feb followed by 7177 kg/ha in 1st March sown crop. Correlation study between weather variables and fruit yield showed that the highest correlation coefficient (r = -0.971**) was obtained with Tmin during reproductive phase followed by BSS (r = -0.962**) during vegetative phase with the fruit yield of okra. Step wise multiple regression model was developed with the combination of Tmin and BSS that explained more than 97% variability in fruit yield of okra.**

Keywords **– Okra, Growth, Fruit yield, Weather.**

I. INTRODUCTION

Okra [*Abelmoschus esculentum* (L.) Moench] is an important vegetable crop belonging to Malvaceae family suitable for tropical and subtropical climates. In India, okra is grown extensively in all over the country in an area of 0.36 million hectares with the production of 3.52 million tons along with productivity of 9.83 t ha^{-1}. In Gujarat state, the crop is grown in an area of 35,190 hectares with the production of 2,73,699 million tons and productivity of 7.78 t ha^{-1} [1]. The fresh fruits of okra are important as human food on account of its taste, flavour and nutritional values. It is rich in vitamin A, B, C and also minerals *viz.* calcium, phosphorous and iron. The green fruits are used in curries, stewed with meats, cooked into soups and canned or dried for off season uses. It is also useful against genitourinary disorders, spermatorrhoea and chronic dysentery [2]. Okra requires a long warm and humid growing period. It can be successfully grown in hot humid areas. It is sensitive to frost and extremely low temperature. For normal growth and development temperature between 24^0C and 28^0C is considered suitable. At 24^0C the first flower bud may appear in the third leaf axil while at 28^0C it may appear in sixth leaf axil. For faster plant growth still higher temperature helps though it delays the fruiting. But at higher temperature beyond 40 – 42^0C, flower may desiccate and drop causing yield losses. The effect of sowing dates on growth and yield of okra has been studied by many researchers like Bisaria and Shamshery [3], Chahal and Mukherji [4], Dhankhar *et.al.* [5] and Das *et al.* [6]. Fruit yield of okra is severely affected by dates of sowing and different kinds of pest and disease. Therefore, to determine the best suitable sowing time for okra crop to get maximum fruit yield, different sowing dates were exposed to different environments in summer season 2009 at Anand.

II. MATERIALS AND METHOD

An experiment was conducted on okra crop during summer season 2009 at Anand in split plot design with five dates of sowing viz. 15th February (D_1), 1st March (D_2), 15th March (D_3), 1st April (D_4) and 15th April (D_5) with four replications. The location is situated at 22°35' N latitude, 72°55' E longitude and altitude of 45.1m above mean sea level falls under semi-arid tropical climate. The soil of experimental site is of alluvial origin classified as "sandy loam" belongs to Entisols order. The recommended packages of agronomic practices were followed in same manner in all the treatments. The growth parameters like plant height and leaf area index (LAI) were recorded periodically at 15 days interval started from 30 days after sowing. The observation of plant height was measured from five randomly selected plants in each plot. It was measured from the ground surface to the base of the upper fully developed leaf. Leaf area index was recorded with the help of LAI-2000 plant canopy analyzer from each plot. The green fruits was picked manually at alternate day and then converted into kg per hectare. The average values of plant height, leaf area index and fruit yield were subjected to statistical analysis and used for results interpretation. The daily meteorological data like bright sunshine (BSS), maximum temperature (Tmax), minimum temperature (Tmin), morning relative humidity (RH_1) and afternoon relative humidity (RH_2) was recorded at Agro-meteorological observatory situated near the experimental site and were averaged phase-wise during crop growth period and correlated with pooled data of fruit yield. The weather variables which have statistically significant highest correlation coefficients were used to develop multiple regression equation for yield prediction. For correlation and regression analysis, SPSS v.10 software was used.

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III. Results and Discussions

The average plant height, leaf area index (LAI) and fruit yield of okra as influenced by the different dates of sowing are presented in Table 1. The results revealed that the plant height and leaf area index (LAI) were significantly higher in early sown crop as compared to letter sown crops. The maximum plant height was 36.5cm recorded in 15th Feb sown crop while lowest (18.9cm) was observed in 15th April sown crop. Similarly, the highest leaf area index (0.64) was recorded in 15th Feb sown crop whereas lowest (0.46) was recorded in 15th April sown crop. The decrease in plant height and LAI with delayed sowing may be attributed to higher ambient air temperatures encountered by the later sown crop which resulted in its stunted growth. The results on fruit yield of okra showed that the fruit yield was produced significantly higher under early sown crops over the latter sown crops. Dilruba *et al.* [6] also observed that the fruit yield of okra significantly affected by sowing time. The fruit yield was decreased significantly with delayed sowing due to unfavorable weather condition i.e. higher ambient air temperature prevailed during later sown crops. The maximum fruit yield (9524 kg/ha) was recorded from 15th Feb sown crop followed by 7174 kg/ha in 1st March sown crop. Hence, the variation in fruit yield and other growth parameters of okra was mainly due to the variability of environment. Katung [7] also found significant differences for all growth parameters of okra crop when it was sown in wet and dry season in Northern Nigeria.

Table 1. Growth and yield as influenced by different date of sowing of okra in summer

Date of sowing	Plant height (cm)	Leaf Area Index (LAI)	Fruit yield (kg/ha)
D_1 (15th Feb)	36.5	0.64	9524
D_2 (1st March)	35.0	0.58	7177
D_3 (15th March)	31.1	0.50	4689
D_4 (1st April)	24.9	0.48	2750
D_5 (15th April)	18.9	0.46	1926
SEm±	1.0	0.04	519
CD at 5%	3.19	0.11	1599
CV%	10	18.6	14

Phase wise weather parameters like bright sunshine (BSS), maximum temperature (Tmax), minimum temperature (Tmin), morning relative humidity (RH_1) and afternoon relative humidity (RH_2) were recorded during crop growth period and correlated with fruit yield of okra (Table 2). The results of correlation study reflected that the Tmax and Tmin showed significant negative correlation while RH_1 and RH_2 showed significant positive correlation with fruit yield of okra during germination phase. The impact of BSS was also positive but statistically found non-significant in germination phase. During vegetative phase all the weather variables except RH_2 indicated significant negative correlation with fruit yield. The variables Tmin, RH_1 and RH_2, were correlated significantly negative with fruit yield of okra during reproductive phase. Titilayo *et al.* [8] also studied on influence of weather elements on phenological stages and yield components of tomato in rainforest ecological zone in Nigeria and stated that fruit yield of tomato was negatively correlated with rainfall, relative humidity and Tmin during reproductive phase. The highest correlation coefficient exhibited by Tmin (r = -0.971**) during reproductive phase followed by BSS (r = -0.962**) during vegetative phase. The effect of BSS and Tmax on fruit yield was found non-significant during reproductive phase. Thus it may be revealed from the correlation study that RH_1 and RH_2, influenced positively to the germination whereas rest of the variables affect negatively. The impact of all variables viz., BSS, Tmax, Tmin, RH_1 and RH_2 was found negatively for vegetative growth of okra. Similarly, the reproductive phase was also affected negatively by no. of weather variables except Tmax.

Table 2. Correlation coefficient between green fruit yield of okra and weather variables

Weather variables	Germination	Vegetative	Reproductive
BSS	0.050	-0.962**	-0.397
Tmax	-0.898**	-0.913**	0.091
Tmin	-0.907**	-0.821**	-0.971**
RH_1	0.836**	-0.486**	-0.821**
RH_2	0.872**	-0.210	-0.960**

Weather variables which have significant and highest correlation coefficient with fruit yield of okra were used to develop multiple regression equation by employed step wise procedure for fruit yield prediction. The regression study revealed that the weather variables Tmin and BSS in combination were found to be more effective as yield predictors. The effect of Tmin during reproductive phase and BSS during vegetative phase was highly significant and negative on fruit yield that explained more than 97 percent variability in fruit yield of okra. Thus the developed model: Y = 50447.306 – 891.034 Tmin – 2245.694BSS R^2 = 0.972** could be used for yield prediction of okra.

Fruit yield = 50447.306 – 891.034Tmin –2245.694BSS R^2 = 0.972**

IV. Conclusion

The results of present finding may be concluded that the growth and yield of okra significantly influenced by sowing date. The crop sown on 15th Feb (D_1) was found superior in terms to produce higher fruit yield and growth performance over the latter sown crops. Effect of Tmin and BSS in combination was more pronounced on fruit yield that explained 97 percent variability in fruit yield of okra. Thus, the fruit yield of okra could be determined well in advance by Tmin and BSS during summer in middle Gujarat region.

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