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Influence of weather parameters on pod yield of groundnut in middle Gujarat agro-climatic region*

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ABSTRACT

Field experiments were carried out during 1997 to 2007 at B. A. College of Agriculture, Anand with two dates of sowing (D_1 : Onset of south-west monsoon and D_2 : 15 days after onset of south-west monsoon), two cultivars (Robut 33-1 and GG-2) and two irrigation regimes (I_1 : Rainfed and I_2 : Irrigation at 50% ASM) for assessing the impact of weather parameters on pod yield of *kharif* groundnut. Results revealed that groundnut crop sown at the onset of monsoon performed better than late sown crop sown 15 days after onset of monsoon rain and on an average, the early sowing gave 21.4% higher pod yield. Robut 33-1 produced more pod yield than the local variety GG-2 in most of the years and on an average, Robut 33-1 yielded 21.6% higher pod yield. During the years of dry spells, irrigations applied at 50% ASM (I_2) recorded greater pod yield than the crop grown under rainfed condition (I_1). In case of crop sown at onset of monsoon, mean temperature during pod development phase showed significant positive correlation with pod yield, whereas in second sowing crop, minimum temperature at 50% pod development phase and sunshine hours at pod development phase also had significant positive correlation with pod yield. Regression models developed were able to account for 38% variation in pod yield in crop sown at onset of monsoon (D_1) and 85 to 92% variation in crop sown 15 days after onset of monsoon (D_2).

Key words : Correlation, groundnut, pod yield, regression model, weather parameters

In India, groundnut is grown in an area of 6.45 million ha with a total production of 6.57 million tonnes, contributing to 26.6 and 18.5% of world's groundnut area and production, respectively. Groundnut occupies nearly 28.3% of the cultivated area under oil seed crops and contributes 31.7% of the total oilseed production in the country. Groundnut productivity declines due to biotic and abiotic stresses. Groundnut is grown mainly as rainfed *kharif* crop during June to September, accounting for about 80% of the total groundnut production and hence, there is high level of year to year fluctuations in the production depending on the rainfall during growing season. The lower productivity of groundnut occurs due to drought, use of low levels of inputs by small and marginal farmers in dry land areas, high incidence of foliar fungal diseases, and infestation of insect pests. The present study was undertaken to assess the impact of weather parameters during different phases of growth on pod yield of *kharif* groundnut.

MATERIALS AND METHODS

Field experiments were conducted during 1997 to 2007 at B. A. College of Agriculture, Anand (22°35´N, 72°55´E; 45.1 m a. m. s. l.) with two dates of sowing (D_1 : Onset of south-west monsoon rain and D_2 : 15 days after onset of south-west monsoon rain), two cultivars (Robut 33-1 and GG-2) and two irrigation regimes (I_1 : Rainfed and I_2 : Irrigation at 50% depletion of available soil moisture i. e. irrigation at 50% ASM) in split plot design with four replications for assessment of role of weather parameters on pod yield of *kharif* groundnut and development of regression models for prediction of yield. The soil of the experimental field was loamy sand in texture having low in available nitrogen and organic matter content, medium in available phosphorus and high in available potassium. The crop was grown as per recommended package of practices. Daily meteorological data of sun shine hours (SSH), rainfall, maximum temperature (Tmax), minimum temperature (Tmin), mean temperature (Tmean), morning relative humidity (RHI), afternoon relative humidity (RHII) and mean relative humidity (RHmean) were collected from nearby agromet observatory. Correlation and regression studies involving pod yield and weather parameters were carried out.

RESULTS AND DISCUSSION

Pod yield

The results (Table 1) revealed that sowing of groundnut at onset of monsoon (D_1) produced higher pod yield in almost all years except 2004. On an average, D_1 produced pod yield of 2169 kg ha^{-1}, as against 1767 kg ha^{-1} produced by the crop

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Table 1: Pod yield (kg ha^{-1}) of groundnut as affected by dates of sowing, varieties and irrigation levels

Treament	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Pooled
D_1	1309	2084	2146	1871	2626	1865	2875	1060	2124	1904	2182	2169
D_2	1009	2167	1510	1427	1881	1440	2412	1641	1715	1818	1864	1787
V_1	1334	2454	1891	1667	2467	1726	3072	1667	1904	1916	2371	2170
V_2	984	1797	1766	1630	2040	1440	2215	1034	1935	1805	1674	1786
I_0	1179	2154	1242	1066	1906	1174	2533	1064	1945	1842	1984	1778
I_1	1140	2097	2415	2232	2601	2131	2754	1638	1894	1880	2061	2178

Table 2: Correlation coefficients between pod yield of groundnut and weather parameters

Weather parameters	Em.	Fl.	Peg.	50% Pod development	Pod development	Maturity
				D_1 : Onset of monsoon rain		
Evaporation	0.309	-0.383	-0.487	-0.134	0.387	0.024
SSH	0.177	-0.267	-0.412	0.01	0.534	-0.211
Rainfall	-0.151	0.301	0.023	0.035	-0.454	0.274
Tmax	0.134	-0.345	-0.464	0.025	0.568	-0.016
Tmin	0.092	-0.516	-0.415	0.182	0.47	0.165
Tmean	0.121	-0.397	-0.485	0.082	0.620*	0.121
RH I	-0.282	0.392	0.431	0.167	-0.434	0.009
RH II	0.001	0.448	0.496	0.012	-0.438	0.049
RHmean	-0.078	0.439	0.505	0.068	-0.45	0.038
				D_2 : 15 days after D_1		
Evaporation	-0.02	-0.37	-0.20	0.21	-0.48	-0.39
SSH	0.06	-0.08	0.12	0.15	-0.67*	-0.48
Rainfall	0.50	0.43	0.53	-0.21	0.40	0.60
Tmax	-0.01	-0.23	0.21	0.19	-0.42	-0.33
Tmin	-0.21	0.00	0.44	0.76**	0.21	0.49
Tmean	-0.05	-0.18	0.30	0.37	-0.25	0.14
RH1	0.26	0.38	0.10	-0.20	0.38	0.30
RHII	0.17	0.33	0.03	-0.02	0.48	0.45
RHmean	0.21	0.36	0.05	-0.06	0.46	0.42

*,**Significant at P=0.05 and P=0.01 level, respectively.

sown 15 days after onset of monsoon (D_2). Thus, 18% higher yield was recorded in D_1 treatment. The higher yield in D_1 was due to fact that crop sown at onset of monsoon made maximum utilization of rainfall and soil moisture, whereas late sown crop yielded lesser due to low temperature and dry weather conditions for considerable period after cessation of monsoon rains in middle of September. Working in different parts of the country, several workers have reported similar findings (Pathi, 1994; Karanjikar *et al.*, 2004; Chandrika *et al.*, 2008). Variety Robut 33-1 recorded higher pod yield (2170 kg ha^{-1}) than GG-2 (785 kg ha^{-1}). Results further showed that irrigated groundnut at 50% depletion of soil moisture (I_2) produced higher pod yield in almost all the years, except in 1998, 2004 and 2005. On an average, irrigated crop produced 2178 kg ha^{-1} pod yield as compared to 1778 kg ha^{-1} by rainfed crop and thus, irrigated crop was able to produce 18.36% higher pod yield than rainfed crop. These findings are in accordance with the results of Janamatti *et al.* (1986). Groundnut is a tropical crop and requires long warm growing season. The favourable climate for rainfed groundnut is well-distributed rainfall of at least 500 mm during crop-growing season, and abundant sunshine and relatively warm temperature. Temperature in the range of 25 to 30ºC is optimum for plant development (Weiss, 2000). The

Table 3 : Regression equations involving pod yield (Y) in kg ha^{-1} and weather parameters during different phases of growth of groundnut

Model No.	Regression equations	R^2	S. E.±
D_1: Onset of monsoon			
1.	Y=-11134.1+468.301 POD Tmean	0.38	424.87
D_2: 15 days after D_1			
1.	Y=-8980.585+673.137 POD Tmin-215.433 PODD Tmean	0.85	162.46
2.	Y=-13832.050+803.879 POD Tmin-259.660 PODD Tmean+82.646 PM Tmax	0.92	128.94

POD Tmean=Mean temperature at pod filling stage., POD Tmin=Minimum temperature at pod filling stage., PODD Tmean=Mean temperature at pod development stage., PM Tmax=Maximum temperature at physiological maturity stage.

productivity of groundnut is higher in soils with pH between 6.0-6.5.

Relationship of pod yield and weather parameters

Based on last 11 years' of data, correlation study was undertaken between pod yield and phase-wise weather parameters, such as sun shine hours (SSH), rainfall, maximum temperature (Tmax), minimum temperature (Tmin), mean temperature (Tmean), morning relative humidity (RHI), afternoon relative humidity (RHII) and mean relative humidity (RHmean). The values of correlation coefficients, presented in Table 2, showed that in case of crop sown at onset of monsoon (D_1), mean temperature during pod development phase showed significantly positive correlation with pod yield, whereas in second sowing crop (D_2), minimum temperature at 50% pod development phase and sunshine hours at pod development phase also had significant positive correlation with pod yield. Similar results were also reported by Virender and Kandhola (2007).

Based on significant association of various weather parameters with pod yield, regression analysis was performed for development of yield prediction models (Table 3). Regression models developed were able to account for 38 % variation in pod yield in crop sown at onset of monsoon (D_1) and 85 to 92% variation in crop sown 15 days after onset of monsoon (D_2).

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