

## Forecasting of groundnut yield using rainfall variables for Saurashtra region of Gujarat state\*

B.A.PARMAR, D.D.SAHU, S.K.DIXIT and B.M.PATOLIYA

College of Agriculture, Gujarat Agricultural University,  
Junagadh - 362 001

### ABSTRACT

Preharvest forecast models for groundnut yield using 25 years (1971-1995) rainfall data were developed for five major groundnut growing districts of Gujarat state. The regression equations incorporating phenophasic rainfall suggested that the flowering & peg initiation were the most critical stages in respect of moisture requirement of groundnut. Preharvest forecasting of groundnut yield could be done at the earliest in second week of August (13-19 Aug.) for Junagadh and Amreli, second week of September (10-16 Sept.) for Bhavnagar and Rajkot, and fourth week of September (24 - 30 Sept.) for Jamnagar district.

**Key words:** Preharvest forecasting, groundnut yield, Saurashtra region.

Saurashtra region on the western coast of India is situated in the peninsular part of Gujarat state. The region comprises of six districts viz. Junagadh, Amreli, Rajkot, Bhavnagar, Jamnagar and Surendranagar. The region accounts for 87% of the total area under groundnut crop yielding 84% of the total production in the state. The area depends mainly on rainfall as only 14 percent of the cultivable land is under irrigation (Annon.1996)

Patel and Mistry (1981) studied the effect of moisture availability and Khatri and Patel (1982) studied the effect of rainfall distribution alongwith the eye estimates for five major groundnut-growing districts of Saurashtra region using 21 years data (1957-77). The effect of rainfall pattern on the yield of groundnut were studied by

several scientists (Suryanarayana *et al.* 1982, Sahu *et al.* 2000).

The preharvest forecasting models for scheduling irrigation in summer groundnut were developed by Khatri and Parikh (1994) in Gujarat State. The present investigation was, thus undertaken to identify the best preharvest forecasting models for groundnut yields based on rainfall variables in different districts of Saurashtra region.

### MATERIALS AND METHODS

Five districts namely Amreli, Bhavnagar, Jamnagar, Junagadh and Rajkot were selected because these areas produce mainly groundnut. The soil type of the districts varies from alluvial sandy in Jamnagar to medium black in other

\*Paper presented in the National Seminar on "Agrometeorological Research for Sustainable Agricultural Production" held at GAU, Anand during 27-28 September 2001.

districts. The normal annual rainfall for the five districts is 590mm, 535mm, 347mm, 938mm and 507mm respectively. The average yield of all the above districts for 25 years from 1971 to 1995 and the corresponding weekly rainfall in respect of districts were taken from the records of the Director of Agriculture, Gujarat State, Ahmedabad. Three rainfall variables such as total monsoon rainfall, phenophasic rainfall and weekly rainfall were used for developing forecast equations. Rainfall received during 23<sup>rd</sup> to 39<sup>th</sup> meteorological standard week is considered as aggregate or total rainfall of the season. The crop growth period was divided into three phenological stages as (i) Germination and flowering (25<sup>th</sup> to 27<sup>th</sup> MSW), (ii) Peg initiation (28 to 31 MSW), (iii) Full pegging to pod development (32 to 36 MSW). Total growth period has been considered as 120 days.

The weekly rainfall during the crop season i.e. from June to September 3<sup>rd</sup> June to 30<sup>th</sup> September (23<sup>rd</sup> to 39<sup>th</sup> MSW) recorded at the weather stations situated in respective districts were used in the study. Rainfall received after 39<sup>th</sup> standard week was excluded, as the purpose of this study was to forecast the crop yield before harvest. For groundnut crop in Saurashtra region about 60 mm rainfall is required to carry out sowing operation.

## RESULTS AND DISCUSSION

### *Total monsoon rainfall approach*

The regression coefficient along with the corresponding coefficient of determination ( $R^2$ ) and standard errors (SE) of the predicted yield are presented in Table 1 for both, with and without sowing dummy. The results revealed that the value of the coefficient of determination ranged

from 0.34 at Jamnagar to 0.56 at Rajkot in case of the model, which did not include sowing dummy variable, whereas, in case of the model which incorporated sowing dummy the values increased to 0.57 at Jamnagar to 0.65 at Rajkot. In all the districts the value of  $R^2$  increased due to inclusion of sowing dummy.

Further, the partial regression coefficient corresponding to sowing dummy was positive and significant in all the districts. This clearly suggests that normal or timely sowing would always result in higher groundnut productivity.

Further inclusion of sowing dummy in the equation, improved the productivity of groundnut. The results also indicated that the regression coefficient corresponding to total rainfall of monsoon season was positive and significant in all the models except in case of Jamnagar and Junagadh districts for the models which incorporated sowing dummy.

### *Phenophasic rainfall approach*

The results clearly indicated that the partial regression coefficient corresponding to the sowing dummy was positive and significant in all the cases except for Bhavnagar district. In all the five districts, the inclusion of sowing dummy improved not only  $R^2$  but also reduced the standard error of the estimated groundnut yield. Inclusion of the sowing dummy variables in the model also enhanced the efficiency and productivity of the model. However, since the value of  $R^2$  did not exceed 0.75, the linear model considering phenophasic rainfall were not considered for forecasting yield.

### *Weekly rainfall approach*

In this approach different regression

Table 1.: Regression equations using total monsoon rainfall for the five districts

| Variables                | Junagadh            |                        | Amreli               |                          | Rajkot               |                         | Bhavnagar            |                         | Jamnagar             |                          |
|--------------------------|---------------------|------------------------|----------------------|--------------------------|----------------------|-------------------------|----------------------|-------------------------|----------------------|--------------------------|
|                          | A                   | B                      | A                    | B                        | A                    | B                       | A                    | B                       | A                    | B                        |
| Constant                 | 390.7               | 192.5                  | 278.9                | 22.5                     | -23.6                | -103.0                  | -14.7                | -58.4                   | 106.5                | 43.2                     |
| Monsoon R.F.             | 0.756**<br>(0.1793) | 0.3841<br>(0.2074)     | 0.9299**<br>(0.2010) | 0.7229**<br>(0.1729)     | 1.1067**<br>(0.2062) | 0.7821**<br>(0.2306)    | 1.4718**<br>(0.2893) | 0.9493**<br>(0.3385)    | 0.8337**<br>(0.2363) | 0.2254<br>(0.2629)       |
| Sowing dummy             | —                   | 596.00**<br>(215.5544) | —                    | 417.2187**<br>(154.0558) | —                    | 343.6908*<br>(142.2245) | —                    | 388.0393*<br>(162.5235) | —                    | 605.8316**<br>(174.5794) |
| R <sup>2</sup>           | 0.43                | 0.58                   | 0.49                 | 0.62                     | 0.56                 | 0.65                    | 0.54                 | 0.63                    | 0.34                 | 0.57                     |
| S.E. for predicted yield | 341.6               | 300.9                  | 260.1                | 229.2                    | 285.5                | 259.5                   | 290.6                | 264.7                   | 390.0                | 322.7                    |

models were tried for each of the five districts, utilizing weekly rainfall data starting from 23<sup>rd</sup> to 39<sup>th</sup> weeks. In all there were 17 weekly rainfall variables.

The predictive equations for different districts, which exhibited R<sup>2</sup> values more than 0.80, are given below. The subscripts indicated the number of standard weeks.

#### Junagadh district

$$Y = 246.2 + 1.640^{**} W_{25} + 1.623^{**} W + 1.8531^{**} W_{31} - 2.154^{**} W_{32} + 727.225^{**} D$$

#### Amreli district

$$Y = 65.73 + 2.769^{**} W_{21} - 1.971^{**} W_{27} + 2.3031^{**} W_{30} + 2.577^{**} W_{31} + 1.263 W_{32} + 623.594^{**} D$$

#### Rajkot district

$$Y = -50.8 + 1.684 W_{25} - 1.539 W_{27} + 2.1927^{**} W + 1.4171 W_{30} + 0.4794 W_{32} + 3.2851 W_{34} + 1.8331^{*} W_{35} + 342.2381^{*} D$$

#### Bhavnagar district

$$Y = -147.6 - 1.782 W_{26} + 5.199^{**} W_{28} + 1.469 W_{29} + 2.164^{*} W_{30} + 6.010^{**} W_{31} + 1.294^{*} W_{32} + 3.279^{*} W_{36} + 411.7075^{*} D$$

#### Jamnagar district

$$Y = -18.5 - 8.718^{*} W_{24} - 1.8941^{**} W_{25} + 1.580^{*} W_{27} + 1.200^{**} W_{29} + 14.218^{**} W_{38} + 666.58^{**} D$$

The examination of the proposed forecast equation revealed favourable impact of the rainfall variable coinciding to germination and vegetative period (W<sub>25</sub>) flowering and peg initiation (W<sub>30</sub> & W<sub>31</sub>) on the groundnut yield for Junagadh district. Whereas for Amreli district W<sub>23</sub> (pre-sowing) W<sub>30</sub> and W<sub>31</sub> (flowering peg

initiation) and  $W_{32}$  (pod development) exerted positive influence. For Rajkot district  $W_{28}$  (flowering and peg initiation) and  $W_{35}$  (pod development) were found to have appreciable positive impact on the groundnut productivity. In case of Bhavnagar district, the variables belonging to flowering and peg initiation stage ( $W_{28}$ ,  $W_{30}$  and  $W_{31}$ ) and full pegging to pod development stage ( $W_{32}$ ) were termed to have positive influence on the groundnut yield. For Jamnagar district positive impact of the variables corresponding to germination and vegetative stage ( $W_{27}$ ) flowering and peg initiation stage ( $W_{29}$ ) and the pod maturation stage ( $W_{38}$ ) was observed.

Khatri and Patel (1982) also reported that for Bhavnagar, Jamnagar and Junagadh districts the weekly rainfall variables corresponding to flowering and peg initiation stage exerted favourable influence on the groundnut productivity. The rainfall variables corresponding to full pegging to pod development stage were reported to have positive impact in case of Amreli, Jamnagar, Junagadh and Rajkot districts. Kalawadia (1983) also reported that the weekly rainfall variables belonging to flowering and peg initiation and full pegging to pod development stages had positive bearing on the groundnut yield for Junagadh district.

The present finding together with reported work, revealed that the quantum of influence of the rainfall variable differs over the districts. This could be attributed to the differing agroclimatic situation in different districts, varieties of groundnut grown, the cropping intensity, cultural practices and soil type. However, from the study it can be concluded that sufficient

rainfall during flowering and peg initiation is very crucial for obtaining high crop yield in case of groundnut in Saurashtra region.

#### REFERENCES

- Anonymous 1996. Statement showing the state wise production and yield of groundnut crop. *Agric. Situation in India* PP. 342-343.
- Kalawadia, R.L. 1983. Estimating of groundnut yield from Soil, Weather and Biometrical parameters. M.Sc. (Agri.) thesis (unpublished) submitted to Gujarat Agricultural University, Sardar Krushinagar.
- Khatri, T.J. and Parikh, R.M. 1982. Preharvest forecasting of groundnut yield in Saurashtra region of Gujarat state. Utilizing eye estimate and rainfall variables. *Guj. Stat. Review*, 9(2) : 49-58.
- Khatri, T.J. and Parikh, R.K. 1994. Preharvest forecasting model for scheduling irrigation to groundnut. *J. Ind.Soc.Ag.Stst.* 46(1):96.
- Patel, K.R. and Mistry, P.D. 1981. Effect of period of moisture availability on groundnut crop in Saurashtra region of Gujarat. *Ind. J. Agric. Sci.*, 51(4):266-270.
- Sahu, D.D., Patoliya, B.M. and Asodaria, K.B. 2000. Studies on rainfall pattern and groundnut productivity in Junagadh region. *J. Agrometeorol.* 2 (2): 140-146.
- Suryanarayana, G., Rajashekara, B.G., Jagannatha, M.K. and Venkataramu, M.N. 1982. Effect of rainfall and its pattern on the yield of groundnut. *Mysore J. Agri. Sci.*, 16(2) :128-133.