Journal of Agroecology and Natural Resource Management
Print ISSN: 2394-0786; Online ISSN: 2394-0794; Volume 1, Number 1; November, 2014 pp. 1-3

http://www.krishisanskriti.org/janrm.html

Crop Yield Forecast at Different Growth Stage of Wheat Crop using Statistical Model under Semi Arid Region

Ananta Vashisth[1], R. Singh[2], Manu Choudary[3]

[1,2,3]*Division of Agricultural Physics*
Indian Agricultural Research Institute, New Delhi-110012

Abstract: **Forecast of crop production before harvests are required for storage, pricing, marketing, import, export etc. The main factors affecting crop yield is weather. Weather variability causes the losses in the yield. Use of weather can be done for crop production forecast. Weather plays an important role in crop growth. Therefore model based on weather parameters can provide reliable forecast in advance for crop yield. A statistical model is used for crop yield forecast at different growth in wheat crop. This model use, maximum and minimum temperature, rainfall, morning and evening relative humidity during crop growing period and last thirty year yield data of that crop. Field experiments were therefore conducted at research farm of IARI, New Delhi for simulating the pre harvest crop yield forecast of wheat during *Rabi* 2011-12, 2012-13 and 2013-14 seasons respectively. Crop yield forecast were simulated twenty five and forty five days before harvest using statistical model. The observed yield after harvest was compared by the simulated yield. Result showed that the percentage deviation of observed yield by simulated crop yield forecast done forty five days before harvest during 2011-12, 2012-13 and 2013-14 was 10.7, 5.7 and 8.53 respectively. However the percentage deviation of crop yield forecast done at 25 days before harvest during 2011-12, 2012-13 and 2013-14 was 9.7, 7.0 and 8.29 respectively. This model is simple, does not required any sophisticated statistical tools, required only weather data for crop growing periods, yield data for past thirty year and provides good pre harvest forecast. Therefore it can be used for district, agro climatic zone and state level forecast.**

Keyword: **wheat, yield forecast, weather indices, statistical model**

1. INTRODUCTION

Wheat is a major cereal crop during *Rabi* season in the northern India. Forecast of the crop production at different stages of crop growth before harvest is useful for advance planning for farmers and planners for preparing advance planning, formulation and its implementation in regard to crop procurement, distribution, price structure and import/export decisions. Efforts in the past has been made by several researchers to develop statistical models baed on time series data on crop-yield and weather variables for pre harvest crop yield forecast. Agrawal et al. (2012) have developed forecast models for wheat yield in Kanpur district using discriminant function analysis of weakly data on weather variables. Rai and Chandrahas (2000) use discriminant function analysis of weather variables to develop statistical model for pre-harvest forecast of rice yield in Raipur district of Chhattisgarth. Ghosh et al (2014) reported that the performance of the district level yield forecast model developed using composite weather indices in predicting yields at district level for various major crops in different states of the country is quiet satisfactory. Therefore in this paper the pre harvest yield forecast of wheat crop were stimulated using statistical model for semi arid region.

2. MATERIALS AND METHODS

Field experiments were conducted at IARI, New Delhi research farm during *Rabi* (2011-12, 2012-13 and 2013-14) seasons respectively for simulating pre harvest yield forecast of wheat crop at twenty five and forty five days before harvest. Two varieties of wheat were sown on three different dates to generate the weather variability at different phenological stages. The crop was raised following the standard agronomic practices with three replications in a randomized block design. Number of days required to attain different phenological stages were recorded. The crop yield forecast was done at forty five days and twenty five days before harvest using the following statistical model. Percentage deviation of estimated yield was done by the observed yield. The crop yield forecast models used stepwise regression analysis. Weather variables are used as independent variables which are related to crop responses such as yield and to account for the technological changes, function of time is used as independent variables.

$$Y = A_0 + \sum_{i=1}^{p}\sum_{j=0}^{1} a_{ij}Z_{ij} + \sum_{i\neq i'=1}^{p}\sum_{j=0}^{1} a_{ii'j}Z_{ii'j} + cT + e$$

Where

$$Z_{ij} = \sum_{w=1}^{m} r_{iw}^{j} X_{iw} \quad and \quad Z_{ii'j} = \sum_{w=1}^{m} r_{ii'w}^{j} X_{iw} X_{i'w}$$

$r_{iw\ is}$ is correlation coefficient of yield with i-th weather variable in w-th period

$r_{ii'w}$ is correlation coefficient (adjusted for trend effect) of yield with product of i-th and i'-th weather variables in w-th period

m is period of forecast

p is number of weather variables used

e is random error distributed as $N(0,\sigma^2)$

Model performance was evaluated by calculating the different statistical parameters viz. Root Mean Square Error (RMSE), correlation coefficient and standard deviation. The RMSE describe the mean absolute deviation between observed and simulated and accuracy of model is characterized by lower RMSE.

3. RESULTS

The crop yield was simulated forty five days before harvest using statistical model. The regression equation developed between different weather parameters is shown in the table 1. The value of correlation coefficient was 0.94 to 0.99. The value of yield simulated was 4171 kg/ha, 3839 kg/ha and 3781 kg/ha and observed yield after harvest was 4673 kg/ha, 4059 kg/ha and 4134 kg/ha during *Rabi* 2011-12, 2012-13 and 2013-14 respectively. The simulated value was compared by observed value after harvest. The percentage deviation of observed value by the simulated value was 10.7, 5.7 and 8.5 during *Rabi* 2011-12, 2012-13 and 2013-14 respectively.

The regression equation developed between different weather parameters for crop yield simulation done twenty five days before harvest is shown in the table 2. The value of yield simulated was 4220 kg/ha, 4365 kg/ha and 4477 kg/ha during *Rabi* 2011-12, 2012-13 and 2013-14 respectively. The value of correlation coefficient was 0.93 to 0.99. The simulated value was compared by observed value. The percentage deviation of observed value by the simulated value was 9.7, 7.0 and 8.3 during *Rabi* 2011-12, 2012-13 and 2013-14 respectively.

4. CONCLUSION

Results from the simulated studies showed that the statistical models based upon the weather indices can successfully simulate pre harvest yield forecast of wheat under semi arid region. The percentage deviation between observed and simulated yield was ranged from 5 to 11 and the correlation coefficient was 0.93 to 0.99. This model is simple, does not required any sophisticated statistical tools, required only weather data for crop growing periods, yield data for past thirty year and provides good pre harvest forecast. Therefore it can be used for district, agro climatic zone and state level forecast.

REFERENCES

[1] Agrawal, R, Jain, R.C. and Jha, M.P. (1986). Models for studying rice crop weather relationship. Mausam, 37 (1): 67-70.

[2] Ghosh, K., Balasubramanian, R., Bandopadhyay, S., Chattopadhyay, N., Singh K. K. and Rathore, L.(2014). Development of crop yield forecast models under FASAL –a case study of kharif rice in West Bengal. Journal of Agrometeorology 16(1): 1-8.

[3] Rai, T. and Chandrahas (2000). Use of discriminant function of weather parameters for developing forecast model of rice crop Publication of IASRI, New Delhi

Table 1 Pre harvest yield forecast of wheat (45 days before harvest) during *Rabi* 2011-12, 2012-13 and 2013-14

Year	Regression equation	Weather element	Correlation coefficient	Standard Deviation	RMSE	Predicted yield (kg/ha)	Actual yield (kg/ha)	% deviation
2011-12	Yield=1297.155+Z141*0.3478+Z231 *1.2238+55.77*Time	Tmax & RHI Tmax & RF	0.99	451	165.8	4171	4673	10.7
2012-13	Yield= 1671.31 + Z141 *0.3554 + Z230* 1.11 + 52.39*Time	Tmax & RHI Tmin & RF	0.94	435	154.3	3839	4059	5.7
2013-14	Yield=1492.3+Z351 *0.163+Z141*0.423+51.17*Time	RF & RHII Tmax & RHI	0.95	443.9	56.6	3781	4134	8.53

Table 2 Pre harvest yield forecast of wheat (25 days before harvest) during *Rabi* 2011-12, 2012-13 and 2013-14

Year	Regression equation	Weather element	Correlation coefficient	Standard Deviation	RMSE	Predicted yield (kg/ha)	Actual yield (kg/ha)	% deviation
2011-12	Yield=1533.46+Z141 *0.3538+Z231*1.0053 + 55.317*time	Tmax &RH I Tmin & RF	0.99	468	165.1	4220	4673	9.7
2012-13	Yield= 1671.31 + Z141 *0.3554 + Z230* 1.11 + 52.39*Time	Tmax & RHI Tmin & RF	0.96	456	149.2	4365	4059	7.0
2013-14	Yield=519.26+Z451 *0.065+Z240*(0.136) +Z230*9.28+50.88*Time	RH I & RH II Tmin &RH I RF & Tmin	0.93	479.6	44.4	4477	4134	8.29