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Validation of CERES-Maize model for growth, yield attributes and yield of kharif maize for NEPZ of eastern U. P.*

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ABSTRACT

The present study was conducted by using data from the experiment carried out at Crop Research Station, N. D. University of Agriculture & Technology, Bahraich (U. P.) during *kharif* 2006 and 2007. The experiment was conducted with three sowing dates in *kharif* season with one cultivar (HQPM-1). Sowing dates of experimental crop were 25 May, 15 June and 5 July. Genetic coefficients required for the CERES-Maize V 4.0 model for simulation of the growth, yield and yield attributes of maize crop have been derived for maize cultivar HQPM-1 for this agroclimatic zone. Simulated values obtained were validated against observed values of field experiment during *kharif* 2008. Results revealed that the simulated values of anthesis, physiological maturity, yield and yield attributes (like stalk, number of grains and test weight) were fairly well with measured values within the error percentage of 3.5, 6.5, 2.8, 23.8, 12.3 and 12.4%, respectively.

Key words : CERES-Maize model, growth, NEPZ, validation

Maize has occupied an important place in India due to its high potential for yield and greater demand for food, feed and industrial utilization. The total production has surpassed over both sorghum and pearl millet giving it a third place after wheat and rice. The demand for maize grain is increasing every year because of its utilization in poultry, piggery and industrial uses. During the year 2008-09, the total area in the country under maize cultivar was 7.32 million hectare against 6.64 million hectare in 2007-08. The total production during the year was 14.93 million tonnes compared to the 2007-08 of 11.15 million tonnes, an increase of 3.78 million tonnes. The productivity during the year was 2039 kg ha^{-1} against 1681 kg ha^{-1} in the previous year. The increase in the area has been reported mainly from the states of Gujarat, Bihar, Uttar Pradesh, Andhra Pradesh, Madhya Pradesh, Rajasthan and Chhattisgarh (Annual Report of AICRPM, CRS, Bahraich, 2009).

Successful prediction of plant growth and yield require appropriate crop growth model and this model was found to be able to predict the phenological occurrence of the crop in advance to decision making for farmers in respect to crop management operations as well planning point of view for better outputs, timely harvesting of crop.

MATERIALS AND METHODS

The experiment was conducted during *kharif* season of 2006 and 2007 at Crop Research Station, N. D. University of Agriculture & Technology, Bahraich (U. P.), India. The experimental site is located at a latitude of $27^0 34'$ North, longitude of $81^0 36'$ East and an altitude of 130 m MSL in the Himalayan foothills of Eastern Uttar Pradesh. The texture of soil was sandy-loam having depth >1 m. The experiment was laid out in randomized block design (FRBD) with four replications and three treatments of sowing date i. e. 25 May, 15 June and 5 July. Crop was sown in *kharif* season at 20 days intervals. The treatments were allocated randomly to each experimental replication. Breeder seeds of hybrid HQPM-1 cultivar were used for sowing. After required preparation of field, 2-3 seeds were dibbled per hill during sowing for different sowing dates. The spacing of crop adopted was 60 x 20 cm. Fertilizer was applied @ 120 kg N, 60 kg P_2O_5 and 40 kg K_2O per hectare. Full dose of phosphorus and potash and one-third dose of nitrogen was applied as basal and the balance N was applied in equal doses at 20-25 days and 45-50 days after sowing. Zinc was applied through $ZnSO_4$ @ 25 kg ha^{-1}. Weeds were removed through hand weeding. Data with respect to growth, yield and yield attributes were carefully recorded from randomly selected plants. The CERES-Maize V 4.0 model was validated during *kharif* 2008 with the genetic coefficients derived (Table 1) from data sets of *kharif* maize 2006 and 2007.

Five plants were randomly selected from each plot. The

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produce from each net plot was weighed separately and per hectare yield was then calculated for each treatment. The weight of the cob was recorded after drying in sun and average weight of cob was calculated. The five randomly selected plants' grain was calculated and weighed. Then average grain weight per cob was calculated. A random sample of 1000 grains from the produce of each plot was taken and its weight was recorded as test weight.

RESULTS AND DISCUSSION

Anthesis (Days)

From Table 2, the predicted mean value of anthesis was 60 days against the observed value of 62.1 days which showed 3.5% error and the error of prediction was very less. The similar results were also obtained by Jones and Kiniry, (1986).

Physiological maturity (Days)

The predicted mean value of physiological maturity was 94 days as against 100.1 days of observed values, which showed 6.5% error (Table 2). The mean difference between predicted and observed values of physiological maturity was 6.1 days that was much closed to predicted values. The results are in tune with those of Ritchie and Alagarswamy (1989).

Grain yield (kg ha^{-1})

Table 2 reveals that the predicted mean value of grain yield was 7760 kg ha^{-1}, while observed value was 7977.3 kg ha^{-1} and this showed 2.8% error. The simulated value was fairly closed with measured values. The similar result was also reported by Hodges *et. al.,* (1987).

Stalk yield (kg ha^{-1})

The mean stalk yield predicted was 11,564 kg ha^{-1} as against 14,316.2 kg ha^{-1} of measured values that showed 23.8% error (Table 2). Thus, error of prediction of stalk yield was much higher and results are in tune with those of Plantureux *et al.* (1991).

Number of grains/Cob

Table 2 shows that the predicted mean number of grains per cob was 210 as against measured values of 235.8, which showed 12.3% of error. The mean difference between predicted and observed was 25.83. The measured value was not very closed to predicted but it was at satisfactory level. Lahrouni, *et al.* (1993) also found the similar results.

Test weight (g)

The mean value of 1000 grains i. e. test weight of maize crop predicted was 222 g as against 250 g observed values, which showed 12.4% error. The mean difference between predicted and observed test weight was 28 g. The result was in tune with that of Carberry *et al.* (1989).

CONCLUSION

The present study is more helpful for planning and advising the farmers to optimize farm operations and marketing crops' produce. Simulated values obtained in respect to grain yield of maize would enable the policy makers to take economic decision.

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Table 1: Genetic coefficients derived of maize cultivar HQPM-1 for NEPZ of Eastern U. P.

P_1	P_2	P_5	G_2	G_3	PHINT
375.0	0.400	750.0	726.0	9.00	40.00

Table 2: Mean values of predicted, observed and their differences alongwith percentage of error of maize crop

S. No.	Parameters	Predicted	Observed	Difference	Percentage error
1.	Anthesis (days)	60	62.1	2.1	3.5
2.	Physiological maturity (days)	94	100.1	6.1	6.5
3.	Grain yield (kg ha^{-1})	7760	7977.3	217.3	2.8
4.	Stalk yield (kg ha^{-1})	11564	14316.2	2752.2	23.8
5.	No. of grains/cob	210	235.8	25.83	12.3
6.	Test weight (g)	222	250	28	12.4

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