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SHORT NOTE

CALIBRATION AND VALIDATION OF GENETIC COEFFICIENTS OF PROCESSING VARIETIES FOR INFOCROP-POTATO CROP SIMULATION MODEL

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Crop simulation models are helpful in integration and utilization of vast interdisciplinary knowledge generated during the last century. A generic crop model INFOCROP was adaptively developed as INFOCROP-POTATO (Singh *et al* 2005a) which has been successfully used for the pre-harvest yield forecasting (Govindakrishnan *et al.*, 2007; Singh *et al.*, 2008), optimizing date of planting, nitrogen and water stress experiments (Singh *et al.*, 2005a; 2005b) *etc*. The model has also been used for impact analysis of climate change on potato production in India (Singh *et al.*, 2010). The model could be useful to rapidly test the location specific suitability and performance of recently released potato varieties for evaluating their adaptation and recommendation of best management practices and various other agronomic studies. However, the model essentially requires model defined genetic coefficients (GC) of these potato varieties. Presently the GC of only 10 prevalent popular table varieties is available (Singh *et al.*, 2003; 2005a). During the last decade emphasis has been on developing potato varieties for processing into chips, French fries and flakes to avoid recurrent gluts. The Central Potato Research Institute has developed specific processing cultivars Kufri Chipsona-1 and Kufri Chipsona-2. The GC of these cultivars has not yet been worked out. Therefore, the GC of these potato cultivars were estimated by field experiments, calibrated and validated for usage by the INFOCROP-POTATO model.

Field studies were conducted on sandy loam soils (Typic Ustochrept) at the Central Potato Research Institute Campus, Modipuram, India (29° 4′ N, 77° 46′ E, 237 masl) during the winter seasons of 2008-2009 and 2009-2010. The experimental crop was planted on 22 October in both the years. The processing varieties Kufri Chipsona-1 and Kufri Chipsona-2 were grown in replicated trials (three replications) with all recommended practices of potato cultivation for processing purposes. Well sprouted seed tubers of 50 g seed weight were planted at crop geometry of 60 × 20 cm in plots of 3.6 × 5 m. The crop was fertilized with elemental N-P-K @ 270-34.9-124.5 kg/ha to grow the crop under almost no stress conditions of nitrogen and water.

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Time course growth data on leaf, stem, tubers, root and the total dry matter was obtained by periodic destructive sampling of 6 plants per replication at 10 days interval starting 30 days after planting till maturity as per recommended procedure (Singh *et al.,* 2008). Development data on days to emergence, tuberization and maturity was recorded (Singh *et al.,* 2008). Weather data during the growing period on solar radiation, temperature and rainfall was collected from the meteorological observatory located at the station. The first estimates of GC were manually computed from the weather, growth and development time course data of 2008-09. The GC were calibrated iteratively through several model runs of INFOCROP-POTATO, till best fit curves between measured and simulated time course data of development stages (emergence, tuber initiation and maturity), growth (LAI, leaf and stem dry weight) and yield (tuber fresh and dry yield) were obtained. These GC were validated against the growth and development data of 2009-10.

The model requires as many as nine GC as follows: TTGERM- Thermal time from planting to plant emergence (degreedays); TTVG-Thermal time from plant emergence to tuber initiation (degreedays); TTGF-Thermal time from tuber initiation to maturity (degreedays); TGMBD- Base temperature from planting to plant emergence (°C); TVBD- Base temperature from plant emergence to tuber initiation (°C); TGBD- Base temperature from tuber initiation to maturity (°C); TPOPT-Optimum temperature for phenological development (°C); TMAX- Temperature above which the rate of development becomes zero (°C); RGRPOT- Index of early growth (unit less index of early vigour, scale 1-5). The calibrated and validated genetic coefficients of the two processing varieties are given **(Table 1)**. The measured and simulated total dry matter (TDM) and fresh tuber yield for both the processing cultivars showed very close agreement **(Fig. 1)**. Similarly the measured and simulated leaf dry matter **(Table 2)** showed very good agreement for Kufri Chipsona-1 (EF= 0.609 and R^2=0.65) and good agreement for Kufri Chipsona-2 (EF= 0.433 and R^2=0.57). The variation in measured data on leaf dry matter is due to nature of destructive sampling and leaf shedding etc. in observations. In contrast the total dry matter being mainly a function of tuber dry matter is more stable entity. The results are similar to the GC for potato grown under short day conditions with acceptable variations among varieties reported earlier (Singh *et al.,* 2005a).

The INFOCROP-POTATO simulation model defined genetic coefficients reported in this paper are acceptable for use in model runs to obtain quick results of various agronomic experiments.

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Table 1. INFOCROP-POTATO defined genetic coefficients of Indian processing varieties.

Varieties	TTGERM	TTVG	TTGF	TGMBD	TVBD	TGBD	TPOPT	TMAX	RGRPOT
Kufri Chipsona-1	270	315	950	4	4	4	25	35	5
Kufri Chipsona-2	270	330	935	4	4	4	25	35	4

Note: TTGERM= thermal time from planting to plant emergence (degree days); TTVG=thermal time from plant emergence to tuber initiation (degree days); TTGF=thermal time from tuber initiation to maturity (degree days); TGMBD=base temperature from planting to plant emergence (°C); TVBD=base temperature from plant emergence to tuber initiation (°C); TGBD= base temperature from tuber initiation to maturity (°C); TPOPT= optimum temperature for phenological development (°C); TMAX= temperature above which the rate of development becomes zero (°C); RGRPOT= index of early growth.

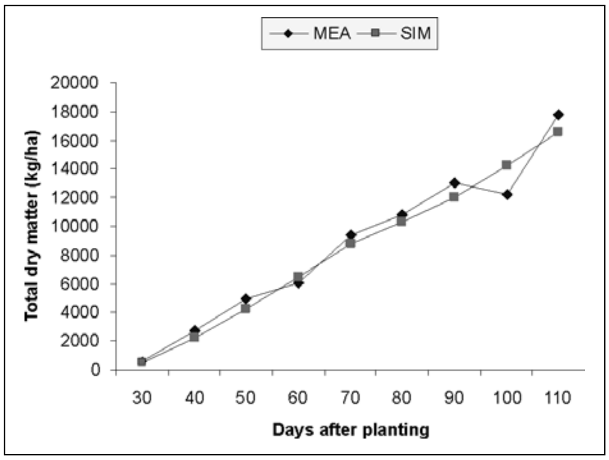

Fig. 1a. TDM of Kufri Chipsona-1 (R^2=0.98)*

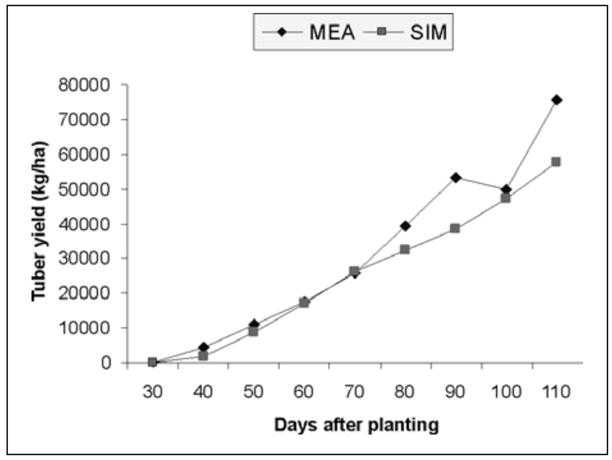

Fig. 1b. Tuber yield of Kufri Chipsona-1 (R^2=0.98)

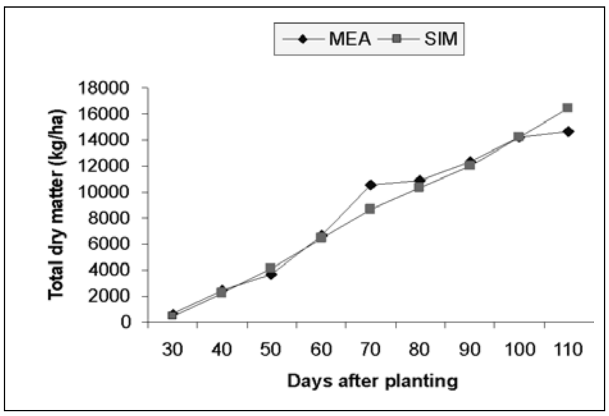

Fig. 1c. TDM of Kufri Chipsona-2 (R^2=0.98)

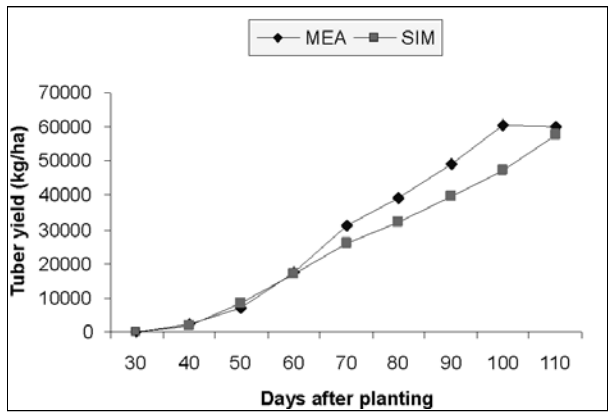

Fig. 1d. Tuber yield of Kufri Chipsona-2 (R^2=0.99)

Fig. 1. Measured (MEA) and simulated (SIM) total dry matter (TDM) and fresh tuber yield of potato processing varieties for validation data set of 2009-10.

Table 2. Measured (MEA) and simulated (SIM) leaf dry matter by INFOCROP-POTATO for processing cultivars grown under potential conditions for validation data set of 2009-10.

Days after planting	Leaf dry matter (kg/ha)			
	Kufri Chipsona-1		Kufri Chipsona-2	
	MEA	SIM	MEA	SIM
30	461	320	474	303
40	1456	1338	1139	1292
50	2015	1876	1419	1834
60	2004	2164	2138	2132
70	3044	2392	3274	2365
80	2197	2178	2153	2155
90	1933	2393	1724	2370

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Days after planting	Leaf dry matter (kg/ha)			
	Kufri Chipsona-1		Kufri Chipsona-2	
	MEA	SIM	MEA	SIM
100	1665	2526	1292	2446
Mean	1847	1898	1702	1862
Modeling efficiency (EF)*	0.609		0.433	

*EF= It indicates whether model predictions provide a better estimate of the measurements than the average value of the observed values. If EF becomes less than zero, the model predicted values are wrong. The maximum value of the EF is 1, which indicates complete agreement between observed and predicted values.

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