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Development of a decision support system for potato crop scheduling in Nilgiri hills of Western Ghats

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ABSTRACT

A decision support system (DSS) tool has been developed for providing information on the optimum time of planting and the likely consequences of early or late planting of potato in about one hundred and seventy three locations of Nilgiris region of Tamil Nadu state in India for the most popular variety of the region i.e., Kufri Jyoti. The effect of harvest at two different durations i.e., 100 and 120 days after planting is also incorporated in this DSS. The tool consists of a database of simulated yield at 100 and 120 days after planting derived through InfoCrop-potato model. This DSS is developed with the data base generated using the daily weather data developed through weather generators and the potential yields estimated with the help of InfoCrop-Potato model. The methodology of development of the data base and the user interface of the DSS has been discussed in this paper.

Key words: Decision support system, Infocrop-potato, model, planting date, potential yield

Nilgiris, a part of Western ghats, represents a unique agro-climatic situation, wherein three crops of potato can easily be grown due to the prevailing humid sub-tropical type of climate. Potato is a highly resource intensive crop and the prevalence of wide fluctuations in prices at the time of harvest makes it a risky crop. Potato is grown in different production situations in Nilgiris which range between 400 to 2600 m above MSL. Out of three crops in a year, *summer* and *autumn* crops are grown entirely under rainfed conditions. The soil types of the region also varied widely between clay loam to sandy loam in different locations. Crop scheduling under such widely varying production situations is much more challenging. Rainfall pattern, altitude and temperature range play major role in planting time as they significantly influence the yield level in potato. Generating recommendations for crop scheduling through field experimentation is an impossible task under such delicate situations and using simulation modeling technique for deriving results seems to be a better alternative. A crop model, InfoCrop-Potato has been developed and calibrated for simulating the growth and development of Indian potato varieties under the sub tropical conditions (Singh *et al.*, 2005a and 2005b), which can be used to generate simulation based results for different locations to help proper decision making. Proper crop scheduling is required to extend the potato cultivation even to non-traditional areas (Shashi Rawat *et al*., 2012). Hence, the present investigation was undertaken during the years 2009, 2010 and 2011 to develop a DSS for potato crop scheduling in Nilgiris under two different seasons i.e., summer and autumn under rainfed conditions for the variety Kufri Jyoti which is the most popular variety of the region.

MATERIALS AND METHODS

This DSS consists of a database (back end in MS Access) and a user interface (front end in Visual Basic). The database consists spatial data *viz* location names and attribute data *viz* InfoCrop-potato model derived yield outputs for two different seasons i.e., *summer* and *autumn* in which potato is grown under rainfed conditions with the variety Kufri Jyoti . Crop simulation model is an aid for a decision support system. In total 173 locations were surveyed and the co-ordinates of each location were collected with the help of GPS instrument. The attribute data was developed like this : Weather database (daily weather data for running InfoCrop model) was generated for each location with the help of NewLoc_clim and Global Rain weather generators. In Nilgiris more than 60 per cent of total potato crop is cultivated during summer season. During summer season, planting is taken up during the month of April with the help of pre-monsoon showers and the south-west monsoon sets

Table 1: Yields of potato (q ha^{-1}) under varying nitrogen levels

N levels	2009		2010		2011	
	Observed	Predicted	Observed	Predicted	Observed	Predicted
Summer season						
0	102.6	121.5	99.7	115.3	111.5	124.3
50	149.7	172.3	138.5	147.2	162.3	186.1
100	273.6	302.4	224.1	234.6	301.4	322.4
150	281.4	311.6	230.2	245.2	312.6	330.4
Autumn season (August third week planting)						
0	124.3	132.6	108.2	124.1	128.2	132.2
50	162.7	182.9	142.6	150.6	158.6	174.9
100	294.1	304.6	276.3	280.5	300.5	310.6
150	302.6	312.7	282.9	291.5	304.3	314.2

Table 2: Model validation parameters for nitrogen levels

Season	MBE	MB%E	R	LR slope	Intercept	EF	CRM
Summer	18.8	9.3	0.9973	1.035	11.74	0.0936	-0.0945
Autumn	10.5	4.9	0.9984	0.9854	13.64	0.0202	-0.0488
General	14.6	7.04	0.9961	1.004	13.799	0.0404	-0.0707

Table 3: Derived potato yield from Info-Crop Potato model at different locations.

Place	Altitude	Duration	Yield (q ha^{-1})	Duration	Yield (q ha^{-1})
Summer season (20th April planting)					
Kallar	485	-99	-99	-99	-99
Barliar	799	82	68	94	102
Gudalur	996	101	110	109	127
Coonoor	1725	97	270	109	285
Kundah	1851	101	235	112	308
Kotagiri	1906	96	253	-99	-99
Ooty	2257	101	197	121	277
Autumn season (20th August planting)					
Kallar	485	-99	-99	-99	-99
Barliar	799	-99	-99	-99	-99
Gudalur	996	-99	-99	-99	-99
Coonoor	1725	99	302	110	315
Kundah	1851	99	335	117	346
Kotagiri	1906	81	287	-99	-99
Ooty	2257	100	292	116	303

-99 represents that the simulated crop has matured earlier to the said duration.

on in the first week of June. Hence, five dates were selected starting from first of April spaced at 10 days interval till 10th of May (1st, 10th, 20th and 30th of April and 10th of May) for running the Infocrop-potato model under rainfed conditions and existing major soil type (loam, sandy clay loam and sandy loam) for each of the locations to generate the simulated results of yield under two different harvesting times (100 and 120 days). For each date of planting, the model was run for the most popular variety Kufri jyoti for which genetic coefficients are available. Similarly, for autumn season crop which is entirely dependent upon North-East monsoon the attainable yield was calculated under five different dates i.e., 1st, 10th, 20th and 30th of August and 10th of September as it is usually planted during mid of August.

Yield output at 100 days or the latest date at which crop matures earlier to 100 days and at 120 days after planting or the latest date at which crop matures after 100 days and at more or less than 120 days at each scenario were extracted and linked to corresponding spatial attributes *viz.* location names in MS Access.

The decision context is defined as the optimum time of planting and harvesting of potato based on the potential yield data obtained from InfoCrop potato model for different sites in Nilgirs. This was planned based on the existing conditions i.e., for summer and autumn seasons each five different planting dates around the general recommended planting time were taken and for each planting date two harvesting periods were considered.

In user interface, the user can extract the desired information through a series of selections in the order of season (i.e., summer or autumn), view details - location (173 locations) and also date of planting. The information pertaining to a particular query is filtered out through these series of selections. Finally the model output in tabular format containing the attainable yield data of the variety Kufri Jyoti at two durations of harvest, corresponding to 100 and 120 days after start of the planting can be derived. In some locations, due to unsuitability of weather, the crop may not stand up to 100 or 120 days in the field and in such conditions the yield at maturity is recorded.

The use of simulation models requires a comparison between estimated and measured data to assess model reliability (Thomas R Sinclair, 2000). To check the accuracy of the DSS as well as the InfoCrop-potato model, the efficiency was tested using certain parameters.

Validation of DSS

For the evaluation of prediction efficiency of the DSS and InfoCrop-potato model for Nilgiri conditions, certain deviance measures, modelling efficiency and coefficient of residual mass and Peason's correlation coefficient were estimated.

RESULTS AND DISCUSSION

Model validation

In the present investigation, the model was validated with the available information from experimental fields of Central Potato Research Station for two different seasons (summer and autumn) for three years (2009, 2010 and 2011) under four different nitrogen levels and available yield data from different locations of Nilgiris obtained from State Department of Horticulture records. For the above data (Table 1), the parameters MBE, MB%E, R^2 and Modelling efficiency were calculated and found that the model predicts potato yields satisfactorily under different nitrogen levels in Nilgiri conditions for the variety K. jyoti.

The positive value for MBE indicates that the model has little over estimated the yields both in summer and autumn seasons. This is mainly because Nilgiris is prone to late blight disease as a regular phenomenon. The effect of late blight is not included in the model. That could be the probable reason for the over estimation. Otherwise, the modeling efficiency being positive and above one indicates that the model has good efficiency to predict the yields under Nilgiri conditions. The correlation coefficient values being almost nearer to 1, indicate that there is perfect correlation between observed and predicted values by the model (Table 2).

The results of few representative areas for summer and autumn seasons, for 20th April and 20th August dates of planting respectively from the present DSS have been summarized in Table 3.

The present DSS could clearly bring out the impact of season, altitude and also the harvesting date on attainable yields of potato (Kufri Jyoti) under different dates of planting as there are clear cut differences in attainable yields of same locations in different seasons at same elevations and differences were also observed between locations with different altitudes in the same season. Similarly, the yield differences were also noticed between different dates of planting at same location and also under different dates of harvest.

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REFERENCES

Shashi Rawat, Govindakrishnan, P.M. and Chauhan, R.K. (2012). Climate based delineation of areas suited for production of ware and processing potato in India. *Potato J.* 39 (1): 75-80

Singh, J.P., Govindakrishnan, P.M., Lal, S.S. and Aggarwal, P.K. (2005a). Increasing the efficiency of Agronomy experiments in potato using INFOCROP-POTATO model.

Potato Res, 48: 131-52

Singh, J.P., Govindakrishnan, P.M., Lal, S.S. and Aggarwal, P.K. (2005b). Infocrop-potato: a simulation model for growth and yield in tropics and Subtropics. SWCACIP,New Delhi, Newsletter, 9 (1): 1-2

Thomas R Sinclair. and No'am Seligman. (2000). Criteria for publishing papers on crop modelling. *Field Crop Res*. 68, 165-172

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