Biological Forum – An International Journal **14(4a): 624-632(2022)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Performance Evaluation of Aquacrop Model for Sweet Corn for Northern Telangana Zone

V. Sai Pratyusha[1*], Y. Siva Lakshmi[2], Guguloth Pragna[3], B. Apoorva[1], S. Rushyamee[1] and Md. Salman Pasha[1]

[1]College of Agricultural Engineering,
Professor Jayashankar Telangana State Agricultural University, Kandi, Sangareddy (Telangana), India.
[2]Department of Agronomy, College of Agricultural Engineering,
Professor Jayashankar Telangana State Agricultural University, Kandi, Sangareddy (Telangana), India.
[3]Department of Agricultural Engineering, Agricultural College,
Professor Jayashankar Telangana State Agricultural University, Polasa, Jagtial (Telangana), India.

(Corresponding author: Sai Prathyusha)*
(Received 01 September 2022, Accepted 18 November, 2022)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: To acquire understanding of the AquaCrop model for crop yield prediction and to calibrate the AquaCrop model in Sweet corn for Northern Telangana zone, a field experiment was conducted for the rabi season 2020–21 at College farm, Agricultural College, Jagtial, PJTSAU. The experimental soil is sandy loam texture, slightly alkaline, and non-saline. Flood irrigation was used to irrigate the sweet corn crop. On the basis of crop evapotranspiration, irrigation was predominantly planned scheduled (ETc). Climate, crop, soil type, management (irrigation), and initial soil water conditions were all provided as input files to the AquaCrop model. The yield and water productivity are simulated using the model. Root mean square error (RMSE) and percentage error(PE) were used to assess the Performance of the model. The results showed that the output actually used is 11% less than the output calibrated using the AquaCrop model. By changing the values of the crop growth coefficients, the model's error in predicting the difference between the measured and simulated grain yield can be further diminished. AquaCrop's simulations of water productivity generally agree with the facts collected through measurement. From the study, it can be concluded that the AquaCrop model is suitable for predicting the grain yield, biomass, water productivity, and green canopy cover in sweet corn for Northern Telangana zone with acceptable under and over range of predictions.

Keywords: Aquacrop, evapotranspiration, canopy cover, water use efficiency and water productivity.

INTRODUCTION

Crop models are useful tools to simulate crop yields in changing environmental contexts. The development of crop models has allowed for the conversion of methods for crop growth and improvement into mathematical equations (Rodriguez and Ober 2019). To mimic the behavior of the system, simulation models are used. For time-variant systems, the simulation model's time step must match the actual lifetime intervals during which there is a measurable and meaningful variation in the driving factors that determine the output (Abedinpour *et al.,* 2012).

AquaCrop is a Windows-based software programme that simulates field crop yield, biomass, and water productiveness responses to varying degrees of water availability (Deb *et al.*, 2016). It is a method for estimating crop production under various water management and climatic conditions (rainfed and supplementary, deficit and full irrigation) (Andarzian *et al*., 2011). The FAO AquaCrop model is user friendly software program that keeps an best stability between accuracy, robustness and simplicity with pretty much less range of input data (Kikoyo and Nobert 2016). The model works on the combined data input fed via user interface and the production potential can be generated via taking in to considerations of soil (per cent of sand, clay, loam), climate (air temperature, reference evapotranspiration and rainfall), crop initial, final and rate of change in percentage canopy cover, biomass water productivity, harvest index, standard management conditions such as irrigation dates and amounts, sowing and harvest dates etc., and field management practices (Steduto *et al.,* 2009). It is mainly appropriate for the improvement of agricultural water management techniques for range of objectives and applications underneath different climatic conditions (Toumi *et al.*, 2016). The AquaCrop model represents an effort to contain present day expertise of crop physiological responses into a tool that can predict the potential yield of a crop primarily based on the water supply available (Vanuytrecht *et al.*, 2014).

Maize (*Zea mays* L.) is the world's main staple crop and is one of the most versatile emerging crops having wider adaptability. Maize is a short duration crop and has high commercial value. Globally, maize is known as queen of cereals due to the fact of its highest genetic yield potential. Maize is a vital crop for billions of people as food, feed, and industrial raw material (Jat and Yadav 2014).

In India, maize cultivation has a key position as it is element of National food security programme (Lakshmi *et al.*, 2020). Maize is the solely food cereal crop that can be grown in diverse seasons, ecologies and uses. Sweet corn (*Zea mays* var. saccharata) is a unique kind of maize turning into very famous in city areas of country now not solely in India however additionally in different Asian countries. Keeping in view of its global demand, its cultivation in peri-urban areas of distinct states of India is growing and emerging as an important urbanite dish (Dagla *et al.*, 2016). Sweet corn is early in maturity with crop duration of only 80-90 days in contrast to ordinary maize of 110-120 days and additionally requires much less water for cultivation i.e., 500-600 mm. Hence it can be better cultivated in low rainfall areas and even with constrained irrigation.

It is consumed as raw, boiled or steamed green cobs/grain. Beside the green cobs the green fodder is also available to the farmers for their cattle. With introduction of good hybrids, its cultivation is remunerative for peri-urban farmers with added market facilities. Hence Sweet corn is taken for the study over maize.

MATERIAL AND METHODS

A. Location of the experimental site

The present experiment was conducted at College farm, Agricultural College, Jagtial. The farm is located at an altitude of 234.4 m above mean sea level at 18^o 49′40″ latitude and 78^o 56′45″ longitude and categorized under the Northern Agro-climatic region of Telangana. According to Troll's climatic classification, it is located in semi-arid tropical region of India.

B. Weather of crop growth period

Weather data required for modelling is collected as mentioned in (Greaves and Wang 2016). The climate of Jagtial is considered as Semi-arid and tropical. The South West monsoon usually starts during second week of June and will withdraw by second fortnight of October giving 40-50 rainy days per year. Winter is usually mild in Jagtial during December-January and temperature starts to rise from second fortnight of January and reaches its peak by May. To characterize or symbolize the weather conditions at the time of crop growing season, the meteorological parameters recorded from the Agrometry located at the Regional Agricultural Research Station (RARS), Agricultural College, Jagtial had been used. The average weekly weather parameters in the course of crop growth period are presented in the figures below (Fig. 1-4). During the crop growth period *i.e.*, from 29th October, 2020 to 7th February, 2021. The weekly mean maximum and minimum temperature ranged from 13.1^{o}C to 33.5^{o}C and 6^{o}C to 18.6^{o}C, respectively (Fig. 1).

The weekly mean maximum and minimum relative humidity ranged from 38.3 % to 96 % and 14.4 % to 56.3 %, (Fig. 2) respectively.

The weekly mean pan evaporation (PE) ranged from 0.8 mm to 4.3 mm (Fig. 3). Total evaporation during the crop study was 39.5 m. There was no rainfall during the entire crop growth period (Fig. 4).

C. Characteristics of the experimental site

(i) Physical, Physico-chemical and chemical properties of soil. Soil samples were collected from 0 to 15 cm soil depth of research field and were analyzed for their physical, physico-chemical and chemical properties by following standard procedures as presented in Table 1. Soil is Sandy loam, slightly alkaline in reaction (7.93) and non-saline (0.22 dSm^{-1}). The fertility status of the experimental soil indicated that it was low in organic carbon content (0.124 %), low in available nitrogen (69.3 kg ha^{-1}), medium in phosphorous (15.75 kg ha^{-1}) and high in available potassium (126 kg ha^{-1}).

(ii) Irrigation water analysis. The source of irrigating the crop was from SRSP Canal water. The water used for irrigating the crop was analyzed to ascertain the quality of water. The irrigation water was alkaline (pH = 7.64) and with moderate EC 0.34 dSm^{-1}.

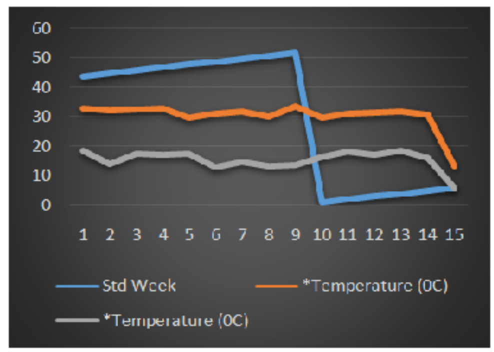

Fig. 1. Weekly average maximum and minimum temperature (°C).

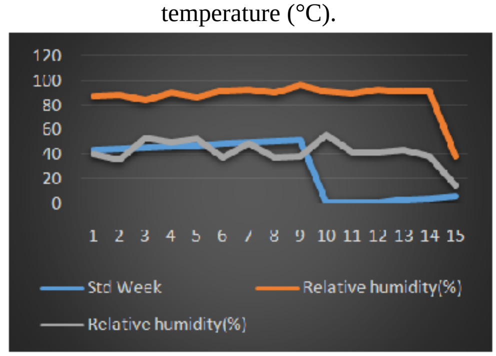

Fig. 2. Weekly average relative humidity (%).

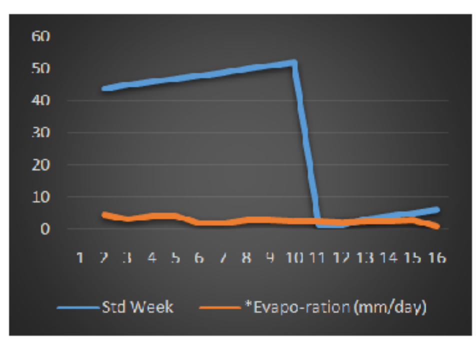

Fig. 3. Weekly average evaporation.

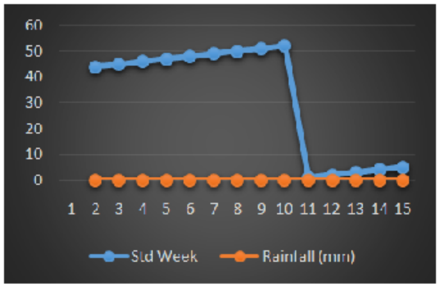

Fig. 4. Weekly average rainfall(mm).

(iii) Bulk density of soil. Bulk density of soil was determined by Core sampler method where a metallic core of known volume is driven into the soil and an undisturbed soil sample is taken from the field. The soil sample is then transferred into pre-weighted aluminium box and dried using oven at 105°C for 24 hours or till no further loss in weight of soil for two days, cooled it and determine the oven-dry weight of sample. Inner dimensions of core sampler were measured to calculate volume of core sampler.

$$BD = \frac{\text{Weight of oven dry soil(mg)}}{\text{Volume of soil core (m}^3\text{)}}$$

D. Experimental Details

(i) Irrigation scheduling. The irrigation scheduling done based on pan evaporation. The irrigation water was applied based on pan evaporation (PE) data obtained from pan evaporimeter installed at Meteorological station, RARS, Agricultural College, Jagtial. The irrigation water was appliedto crop at an interval of 10 days using border irrigation method.

E. Cultivation details

(i) Field preparation. The experimental field was first ploughed with tractor drawn disc plough followed by two ploughings were done with the cultivator. As a final land preparation rotavator was used to break the clods and the land is levelled uniformly. The bunds were prepared to separate the replicated plots.

(ii) Fertilizer application. The fertilizer dose of 200:80:80 N, P, K were applied to sweetcorn. Nitrogen, phosphorous and potassium were applied in the form of urea, single super phosphate and muriate of potash respectively. Basal dose of 20 kg N ha^{-1}, full dose of P_2O_5 and K_2O were applied.

(iii) Seeds and sowing. Sowing of Sweetcorn was done on 29th October 2020 with Sugar 75 variety of Syngenta Company with a row to row spacing of 60 cm and plant to plant spacing of 20 cm. Required seed rate is 4 kg $acre^{-1}$. First irrigation was given immediately after sowing using border irrigation method.

(iv) Thinning. The thinning operation was done by leaving one healthy seedling per hill.

(v) Weeding. Hand weeding and earthing up was done at 55DAS.

(vi) Plant protection. Necessary plant protection measures were adopted as and when required for the control of common insect pests of Sweet corn during the experimental period. After sowing Atrazine (a pre-emergence herbicide, which prevents broadleaf weeds) was applied to the crop.

(vii) Harvesting. The green cobs were harvested on 31-01-2021 *i.e.,* 94 DAS. Cobs were harvested by observing maturity symptoms like full size with tight husk, dry brown silk, smooth and plumpy kernels which exude milky liquid when punctured with thumb nail.

F. Observations recorded

Ten plants in a square plot were marked in the net plot area and in addition to these ten plants were selected randomly and labelled with tags for recording observations throughout crop period.

(i) Growth characters

Plant height. Plant height was measured from ground level up to the tip of growing point (after every 15 days) from the date of sowing for the entire crop period and mean was expressed as plant height in cm.

Table 1: Soil properties of experimental site.

Sr. No.	Particulars	Value						Method or reference
I	**Physical properties**	**Sample no.**						
1.	Mechanical analysis							
	Soil analysis	1	2	3	4	5		Sieve analysis
	a) Total weight	290.7	214.7	314.5	237.1	256.3		
	b) Over-sized weight	151.8	113.7	167.1	116.4	122.3		
	c) Under-sized weight	139.0	101.2	147.6	130.7	133.6		
	d) Gravel percentage	52.2	52.9	53.1	49.0	47.7		
2.	Textural class	Sandy loam						
II	**Physico-chemical properties**	**Sample no.**						
	Sample no	1	2	3	4	5	Nature	
1.	pH	7.93	7.72	7.83	7.89	7.76	Alkaline	pH meter
2.	Electrical conductivity(dsm^{-1})	0.22	0.29	0.30	0.18	0.27	Safe	EC meter
3.	Organic carbon	0.124	0.15	0.2	0.13	0.18	low	Walkley and black's method
III	**Chemical properties**							
	Sample No.	1	2	3	4	5	Nature	
1.	Available N (kg/ha)	69.3	70.1	68.2	56.4	69.8	Low	Kelplus
2.	Available P (kg/ha)	15.75	13.3	13.1	14.6	15.2	Medium	Spectrophotometer
3.	Available K (kg/ha)	585	486	424	532	372	High	Flame photometer

Number of leaves plant^{-1}. Number of branches in the marked plants were counted during the various stages of crop period and mean was expressed as number of branches plant^{-1}.

Leaf area and Leaf area index. Leaf area plant^{-1} was measured using *BIOVIS Leaf Av* portable leaf area meter which gives area, length, width, perimeter. The samples collected for dry matter estimation were used to calculate the leaf area.

Leaf area index is the ratio of leaf area per plant (A) to land area per plant (P). It was calculated by using the formula outlined by Sestak *et al.* (1971).

$$\text{leaf area index} = \frac{\text{leaf area}}{\text{land area}}$$

Dry matter production. Five plants were selected at random from the crop area. Selected plants were cut, sun dried initially and then oven dried till constant weight was obtained and their weights were recorded. Dry matter production was recorded after every 15 days from the date of sowing (Popova and Pereira 2011).

SPAD chlorophyll meter reading (SCMR). Chlorophyll is an important parameter that is a measure of plant health which can be used to SPAD meter is a portable, simple and non-destructive chlorophyll meter suitable to use for the estimation of relative leaf chlorophyll content of plants (Diaz *et al*., 2010).

The Konica Minolta SPAD-502 plus chlorophyll meter was used for estimating chlorophyll without damaging leaf at various crop stages.

Days to 50 % flowering. The duration in days taken by 50% of the plants in the net plot area to reach flowering based on visual observation from the date of sowing was taken as days to 50 % flowering and expressed in days.

G. Yield attributes

(i) Number of cobs plant^{-1}. The total no of cobs from each marked plant in square plot was counted, averaged and expressed as number of cobs plant^{-1}.

(ii) Number of rows cob^{-1}. Number of rows cob^{-1} for five plants is counted, averaged and recorded.

(iii) Number of kernels row^{-1}. Number of kernels row^{-1} in a cob for five plants were counted and average was recorded.

(iv) Cob length. Length of five cobs was measured at harvesting and expressed as cm plant^{-1}.

(v) Cob width. Width of five cobs was measured at harvesting and expressed as cm plant^{-1}.

(vi) Cob weight. Weight of five cobs was recorded at harvest, averaged and expressed as cob weight plant^{-1}.

(vii) Test weight. Five test samples of each 100 grains of five cobs, of five different plants were drawn from the net plot yield and weight was recorded and mean was expressed in grams.

(viii) Yield

Green cob yield with husk. The green cobs harvested from the net plot were weighed and expressed in t ha^{-1}

(ix) Crop water requirement

Total water applied. Total water applied in each irrigation treatment was calculated as follows:

Total water applied(mm) = sum of water applied in all irrigations + effective rainfall

Note: There was no rainfall during the entire crop period, hence taken as zero.

(x) AquaCrop modelling

The AquaCrop Model. AquaCrop (V6.0 March, 2017) was developed by the Food and Agriculture Organization (FAO) of the United Nations to simulate yield, crop water productivity, and total soil water content (Oktem *et al.,* 2003). It is open source software. There is no need for any specialised hardware or auxiliary software; it only requires the Microsoft Windows operating system (version 98 and higher). It can replicate various management techniques like fertiliser, deficit irrigation, soil salinity, and various soil management techniques. It needs a little amount of easily gathered input data from the field. AquaCrop employs a predefined data base for the various crop parameters while simulating various crops.

Description of the model. The soil (water balance), the crop (development, growth, and yield), the atmosphere (temperature, rainfall, evapotranspiration (ET), and carbon dioxide (CO_2) concentration), and management (major agronomic practices such as planting dates, fertilizer application and irrigation if any) are the four sub-model components of AquaCrop. AquaCrop generates a daily water balance that accounts for changes in soil water content as well as all entering and leaving water fluxes (infiltration, runoff, deep percolation, evaporation, and transpiration).

AquaCrop needs a minimal amount of data for its simulations, which can be acquired or determined using straight forward techniques. The inputs are simply editable through the user interface and are saved in the climate, crop soil, and management files.

Meteorological data. The weather data required to run AquaCrop includes daily maximum and minimum air temperature (T), daily rainfall, daily reference evapotranspiration (ET_O) and the mean annual CO_2 concentration in the bulk atmosphere. Information about calculation of ET_o and data required for its calculations are specified in the tabular sheet 'ET_o'.

Climatic parameter and Symbol	Possible units
Air temperature data	
Maximum air temperature (Tmax)	°C or °F
Mean air temperature (Tmean)	°C or °F
Minimum air temperature (Tmin)	°C or °F
Air Humidity data	
Maximum Relative Humidity (RHmax)	%
Mean Relative Humidity (RHmean)	%
Minimum Relative Humidity (RHmin)	%
Dewpoint temperature (Tdew)	°C or °F
Actual vapour pressure: e(act)	kPa, mbar, psi, atm or mmHG
Temperature of dry bulb (Tdry)	°C or °F
Temperature of wet bulb (Twet)	°C or °F
Wind speed data	
Wind speed at x m above soil surface: u(x)	m/sec, km/day, knot or ft/sec
Radiation and sunshine data	
Actual duration of sunshine in a day (n)	hour
Relative sunshine duration (n/N)	-
Solar or shortwave radiation (Rs)	MJ/m².day, W/m², J/cm².day, mm/day, cal/cm².day
Net radiation (Rn)	MJ/m².day, W/m², J/cm².day, mm/day, cal/cm².day
ETo, Reference crop evapotranspiration	
Direct import of reference crop evapotranspiration (ETo)	mm/day
Rainfall data	
Rainfall (Rain)	mm or inch

Fig. 5. Climate parameters and symbol.

Coordinates of Meteorological station (Altitude and Latitude). They are required for the calculation of the psychometric constant (γ), extra-terrestrial radiation (Ra) and maximum hours of bright sunshine or day length (N).

Climatic data considered for ET_o calculation. ET_o is calculated with the FAO Penman Monteith method according to the calculation procedures outlined in the FAO Irrigation and Drainage Paper No. 56 (Allen *et al.*, 1998). To compute ET_o (i) air temperature, (ii) air humidity, (iii) radiation and (iv) wind speed data are required. While maximum and minimum air temperature, air humidity, solar radiation and wind speed data is obtained from the agro meteorological station, Agricultural College, Jagtial.

Soil data. Different horizons in a soil profile, each with unique physical properties, can be observed. Utilizing AquaCrop's suggestive values for the various soil textural classes, the user can import locally calculated or derived data from soil texture using pedo-transfer functions.

Crop data. The Food and Agriculture Organization has calibrated parameters for the main agricultural crops that are not location-specific but crop-specific, and provided default values in the model. Since these criteria don't significantly change with time, management techniques, or geographic location, they are called to being conservative. They are calibrated using data from crops produced under optimum and unrestricted settings, but thanks to the regulation of their reaction to stress, they are still usable under stressful circumstances. In addition, the user must supply user- or cultivar-specific parameters that are specific to a given cultivar. It is acknowledged that in the near future, it will not be able to calibrate the model effectively for all crop species. Owing to the unavailability of more detailed data, AquaCrop also provided default or sample values for all necessary parameters as a place to start for unexplored crops.

Production potential. It is crucial to have information on the water productivity normalised for ET_o and air CO_2 concentration (WP) as well as the representative Harvest Index (HI) for the selected crop species under non-stress conditions in order to simulate biomass and yield (HI_o). Given that local soil conditions have a significant impact on root development, the WP and HI_o parameters are cautious. Cultivar-specific is the other.

Model statistics. Criteria based on statistics offer a more objective way to assess the performance of the models. Error percent (Pe) and root mean square error calculations were used to determine the effectiveness of the simulation (RMSE). The computed values of RMSE determine the degree of agreement between the simulated values and their respective observed values. A low RMSE value that approaches 1 is ideal:

$$\mathrm{RMSE} = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(O_i - S_i)^2}$$

Where,
n = No. of observations;
O_i= Observed value; S_i = Simulated value.

Error % (P_E). Error % was calculated by using following formula

$$\text{Error (\%)} = \left[\frac{\text{Simulated} - \text{Observed}}{\text{Observed}}\right] \text{x100}$$

RESULTS AND DISCUSSION

Using data from experiments, AquaCrop was assessed for growth, development, and yield of the sweet corn crop. Field data on crop growth parameters, soil properties, crop management, and climatic information were gathered, and these data were utilized as input to calibrate yield and water productivity. Throughout the season, five replicated plant samples were taken from the field every 15 days. On each sample, the leaf area index and biomass, segmented into stems, leaves and pods were assessed. On the basis of the plot area, the final yield was calculated.

Model Run: The parameters of the crop, the environment in which it is grown (climate, management, soil), and growth season are fed as input files at the beginning of the simulation run. By default, the input files are kept in the AquaCrop folder's DATA subdirectory. The following sections describe the choice, creation, and use of input data files:

Table 2: Observations on growth Parameters.

DAS	Mean plant height (cm)	Mean dry matter Produced (kg)	Mean chlorophyll content (%)
30	46.95	0.005	46.63
50	102.2	0.0126	38.61
65	148.4	0.0254	46.9
85	215.6	0.1072	58.99

Table 3: Observation on yield attributes and yield.

Yield Attribute	Value
Length of cob	18.8 cm
Width of cob	12.7 cm
No. of rows Cob^{-1}	13
No. of kernels row^{-1}	34
Test weight of 100 kernels	30.8 gm

Climate files(*.CLI). The atmospheric environment of the crop is described in the climate component of AquaCrop as 5 weather input variables: daily maximum and minimum air temperatures, daily rainfall, daily evaporative demand of the atmosphere, expressed as ET_o, and the mean annual carbon dioxide concentration in the bulk atmosphere. While the first 3 are obtained from data of agro meteorological station at Regional Agricultural Research Station, Jagtial and data regarding the CO_2 concentration is considered as the Mauna Loa which is default input file in the AquaCrop. ET_o is derived from weather station data by means of default ET_o calculator in the AquaCrop which uses the FAO Penman Monteith equation to compute ET_o (Allen *et al.,* 1998).

Coordinates of Meteorological station(Altitude and Latitude): They are required for the calculation of the psychrometric constant (γ), extra-terrestrial radiation (Ra) and maximum hours of bright sunshine or day length (N).

Climatic data considered for ET_o calculation:

1. Air Temperature (Maximum and minimum temperature, °C)
2. Air Humidity (Mean relative humidity, %)
3. Radiation (No. of bright sunshine hours hrsday^{-1})
4. Wind speed (wind velocity, m sec^{-1})
5. Rainfall, (mm) data are required.

The required climatic data are stored in respectively as:a) Temperature files (files with extension 'Tnx') b) ET_ofiles (files with extension '.ET_o') c) Rainfall files (files with extension 'PLU')

Crop files (*.CRO). Crop parameters describing its development, evapotranspiration, production (biomass and yield), and its response to soil water, temperature, salinity and fertility stress, are stored in crop files. Adapted crop parameters used in AquaCrop to evaluate sweet corn productivity containing crop characteristics are given as below:

Irrigation files (*.IRR). This irrigation files contains the irrigation method, applied irrigation amounts and the irrigation water quality of an irrigation schedule. Flood irrigation method is adopted for the experiment. Schedule of irrigation, amount of irrigation is fed into the AquaCrop as shown below:

Field management files (*. Man). The characterstic file consists of the field on which the crop is cultivated. No specific field management conditions are considered to run AquaCrop in this case. It is assumed that field does not affect soil evaporation or surface run-off.

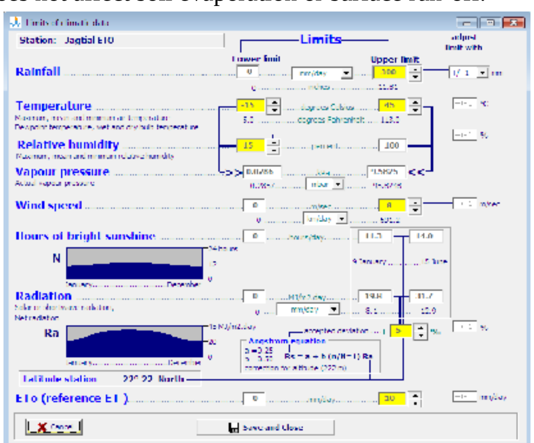

Fig. 6. Limits of climate data.

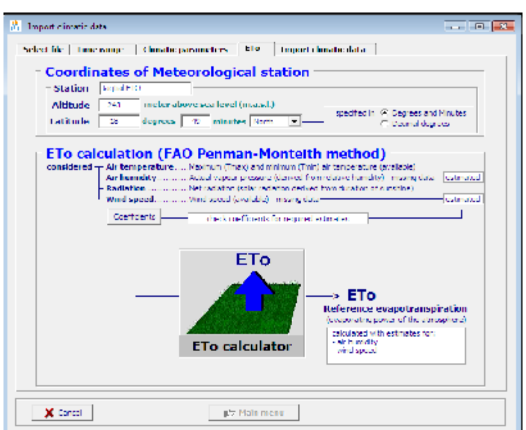

Fig. 7. Coordinates of meteorological station.

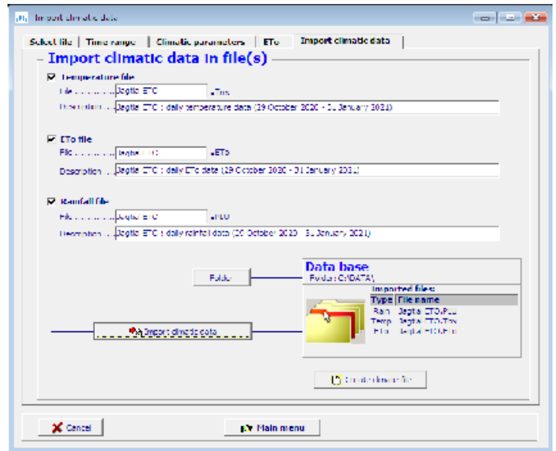

Fig. 8. Import of climate data files.

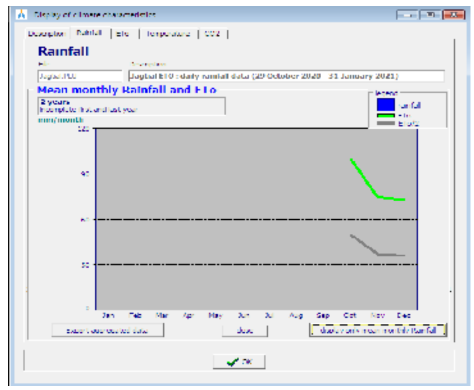

Fig. 9. Display of climate characteristics.

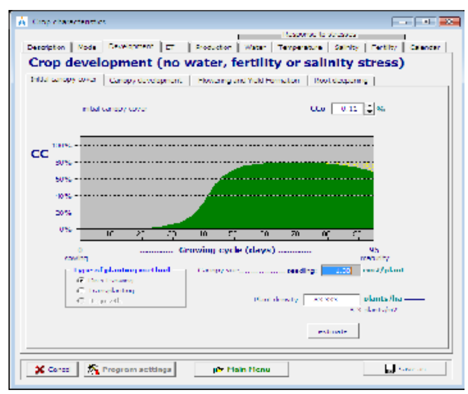

Fig. 10. Initial canopy cover.

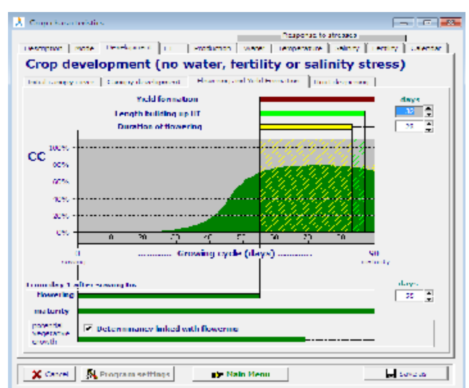

Fig. 11. Flowering and yield formation.

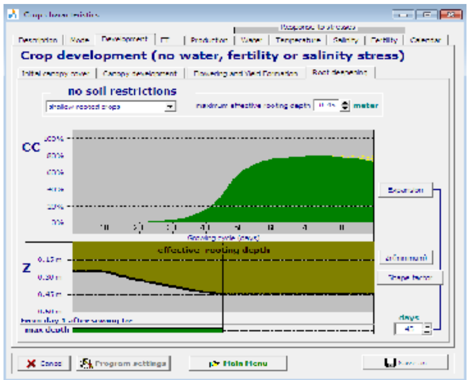

Fig. 12. Root deepening.

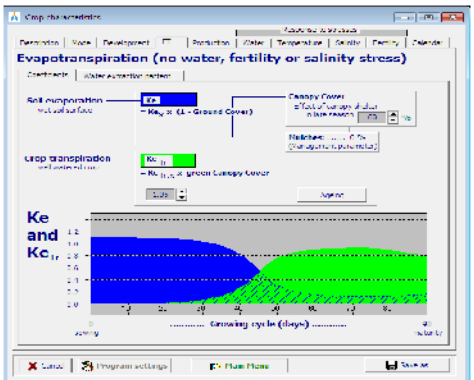

Fig. 13. Crop characteristics- ET_O.

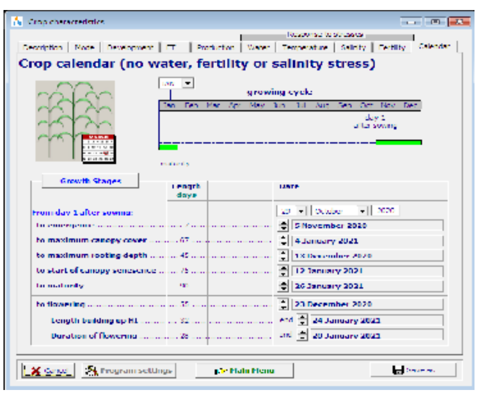

Fig. 14. Crop characteristics-Crop calender.

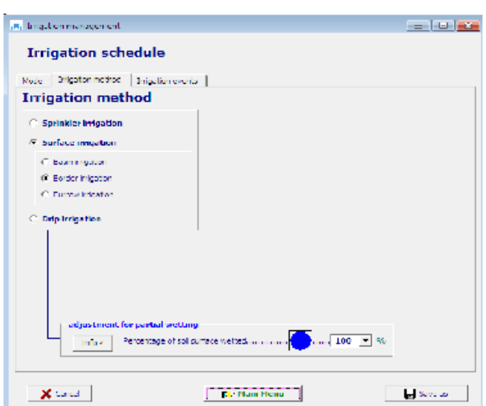

Fig. 15. Irrigation management.

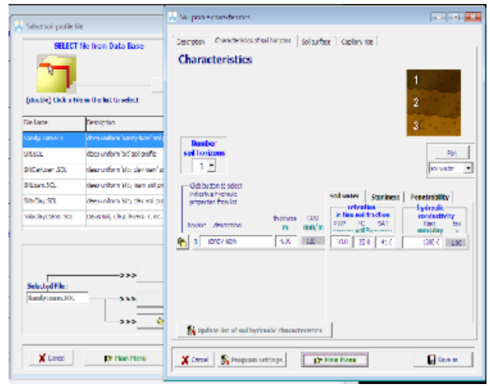

Fig. 16. Soil characteristics.

Soil profile files (*.SOL). It is containing characteristics of the soil profile. Soil samples of experimental field were analyzed for their physico-chemical properties by adopting standard procedures. Soil textural class was indicated to be sandy loam. The soil water contents (SAT, FC or DLL, and PWP or DUL) for each of the soil horizons are derived from soil texture properties and with the help of pedo transfer function SPAW.

Groundwater files (*.GWT). It contains characteristics of the groundwater table. The considered characteristics of the groundwater table are (i) its depth below the soil surface and (2) its salinity. The characteristics can be constant or vary throughout the year. Here ground water file is not considered for the actual location hence "no shallow groundwater table" is assumed when running a simulation.

Files with the specific conditions in the soil profile at the start of the simulation period (*.SW0). At the start of the simulation, the soil moisture and salinity of the soil profile are specified in the file of initial conditions (files with extension SW0). If the field is surrounded by levees, the SW0 file also indicates the water depth and water quality above the soil surface at the start of the simulation.

Files with off-season field management conditions (*.OFF). Off-season files contain data on site management (with or without mulching) and irrigation management conditions (irrigation events and irrigation water quality) during off-season (eg before and after growing season). Default file with off-season conditions, no mulches and irrigation events are considered before and after the growing cycle.

Model performance: Calibration of AquaCrop for soil and yield parameters was done through trial-and-error method.

The parameters were varied within a physically realistic range to provide an optimal configuration of the parameters. First, the soil parameters were calibrated with the default crop parameters for each crop. Using the final soil parameters, the crop file in AquaCrop was modified to simulate the observed crop parameters as closely as possible. As crop characteristics significantly affect the soil moisture balance in AquaCrop, re-simulated the soil moisture balance after calibrating the crop parameters.

It is observed that the canopy cover gradually increases up to 67 days after sowing (DAS) and attained maximum cover at 67 DAS. Further, the green canopy cover showed a decreasing trend till harvest. The obtained grain yield results simulated by the AquaCrop model are very consistent with acceptable over and under-estimated ranges. By adjusting the values of the crop growth factors performed in this study, it is possible to reduce the model prediction error between the measured and simulated grain yields. The results of water productivity simulations using AquaCrop are in quite agreement with the measured data.

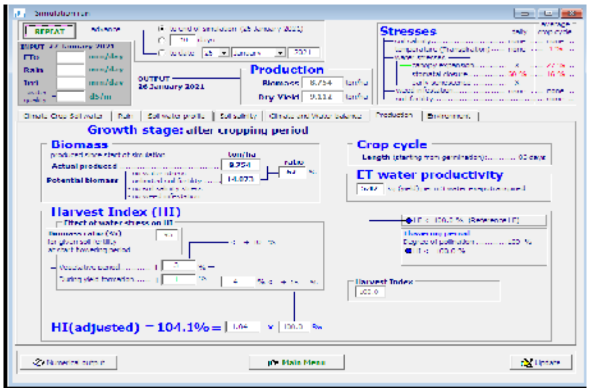

Fig. 17. Simulation run of AquaCrop model.

SUMMARY AND CONCLUSIONS

Weather data *viz.*, the weekly mean maximum and minimum temperature ranged from 13.1°C to 33.5°C and 6°C to 18.6°C, the weekly maximum and minimum relative humidity ranged from 38.3 % to 96 % and 14.4 % to 56.3%, the weekly mean pan evaporation ranged from 0.8 to 4.3 mm, total evaporation during the crop study was 39.5 mm and no rainfall was recorded during the entire crop period.

Soil samples collected from the experimental plot were analyzed and physical, physio-chemical and chemical properties were determined *viz.*, gravel percentage was 51.10 %, soil texture was sandy loam, PH was 7.826, EC was 0.374, organic carbon content was 0.156 %, available N, P and K was found to be 66.76 kg ha^{-1}, 14.39 kg ha^{-1} and 479.8 kg ha^{-1}.

Irrigation water analysis was done to determine properties *viz.*, pH was 7.64 and EC was 0.34.

Growth characters at 85 DAS *viz.*, mean plant height was 215.6 cm, mean dry matter produced was 0.1072 kg, mean chlorophyll content was 58.99 %, mean dry matter weight of cob was 0.042 kg.

Yield attributes *viz.*, cob length was 18.8 cm, cob girth was 12.7 cm, no of rows cob^{-1} was 13, no of kernels row^{-1} was 34 and test weight of 100 kernels recorded was 30.8 gm, green cob yield obtained was 8.107 t ha^{-1}.

AquaCrop's Climate components *viz.*, five weather input variables i.e., maximum and minimum daily air temperatures, daily precipitation, daily evaporative demand of the atmosphere, in ET_o, and the mean annual carbon dioxide concentration in the bulk atmosphere. While the first three components dataare obtained from weather station AGROMET at Regional Agricultural Research Station, Jagtial. ET_o is derived from weather station data using AquaCrop's default ET_o calculator which computes ET_o using the FAO Penman Monteith equation. The data regarding the CO_2 concentration is considered as the Mauna Loa which is default input file of the AquaCrop.

The climatic data required to run AquaCrop model were saved respectively as temperature files with extension 'Tnx', ETo files with extension 'ETo', Rainfall files with extension 'PLU'.

Canopy growth coefficient (CGC), Canopy decline coefficient (CDC), cultivation under flood irrigation were the methods adopted for running AquaCrop model for sweet corn.

For calculation of root mean square error (RMSE), the experiment needed to be conducted for different irrigation treatments. Here we have given only flood irrigation *i.e.*, one treatment hence cannot be calculated. By conducting for more than one treatment RMSE can be calculated.

AquaCrop model can be adopted for any crop. The model is suitable to be adopted for climate of Northern Telangana zone.

CONCLUSIONS

1. AquaCrop is suitable for yield prediction in Sweet corn in Northern Telangana Zone.
2. The resulting yield was 11% less than that calibrated with the AquaCrop model. The difference between the measured and simulated grain yields can be minimised by modifying the crop growth coefficient values. The results of AquaCrop's simulation of water production and the collected data agree fairly well.

According to the findings of this study, the AquaCrop model is appropriate for forecasting Sweet corn crop production, biomass, water productivity, and green canopy cover in acceptable and predictable ranges. The model can be used for the Northern Telangana zone's sweet corn production.

Acknowledgement. The contents and views expressed in this research article are the views of the authors and do not necessarily reflect the views of the organizations they belong to.

Conflict of Interest. None.

REFERENCES

Abedinpour, M., Sarangi, A., Rajput, T. B. S., Singh, M., Pathak, H. and Ahmad, T. (2012). Performance evaluation of AquaCrop model for maize crop in a semi-arid environment. *Agricultural Water Management, 110*, 55-66.

Allen, R. G., Pereira, L. S., Raes, D. and Smith, M. (1998). FAO Irrigation and drainage paper No. 56. *Rome: Food and Agriculture Organization of the United Nations*, *56*(97), p.e156.

Andarzian, Bannayan, M., Steduto, P., Mazraeh, H., Barati, M. E., Barati, M. A. and Rahnama, A. (2011). Validation and testing of the AquaCrop model under full and deficit irrigated wheat production in Iran. *Agricultural Water Management, 100*(1), 1-8.

Dagla, M. C., Kumar, N., Chandrashekar, A. and Ram, C. (2016). Popular Kheti. January.

Deb, P., Tran, D. A. and Udmale, P. D. (2016). Assessment of the impacts of climate change and brackish irrigation water on rice productivity and evaluation of adaptation measures in Ca Mau province, Vietnam. *Theoretical and Applied Climatology*, *125*(3-4), 641-656.

Greaves, G. E. and Wang, Y. M. (2016). Assessment of FAO AquaCrop model for simulating maize growth and productivity under deficit irrigation in a tropical environment. *Water*, *8*(12), 557.

Jat, A. K. S. L. and Yadav, R. K. O. P. (2014). Maize production systems for improving resource-use efficiency and livelihood security. In Directorate of maize research pusa campous, New Delhi (Issue February 2014).

Kikoyo, D. A. and Nobert, J. (2016). Assessment of impact of climate change and adaptation strategies on maize production in Uganda. *Physics and Chemistry of the Earth, 93*, 37–45.

Lakshmi, S. Y., Sreelatha, D. and Pradeep, T. (2020). Performance evaluation of sweet corn with different levels of irrigation and nitrogen through drip during post monsoon season at Rajendranagar, Hyderabad. *International Journal of Environment and Climate Change*, *10*(12), 362-372.

Oktem, A., Simsek, M. and Oktem, A. G. (2003). Deficit irrigation effects on sweet corn (*Zea mays* saccharata Sturt) with drip irrigation system in a semi-arid region I. Water-yield relationship. *Agricultural Water Management*, *61*(1), 63–74.

Popova, Z. and Pereira, L. S. (2011). Modelling for maize irrigation scheduling using long term experimental data from Plovdiv region, Bulgaria. *Agricultural Water Management, 98*(4), 675–683.

Rodriguez, A. V. C. and Ober, E. S. (2019). AquaCropR: Crop growth model for R. Agronomy, *9*(7), 0–9.

Steduto, P., Hsiao, T. C., Raes, D. and Fereres, E. (2009). Aquacrop-the FAO crop model to simulate yield response to water: I. concepts and underlying principles. *Agronomy Journal*, *101*(3), 426–437.

Toumi, J., Er-Raki, S., Ezzahar, J., Khabba, S., Jarlan, L. and Chehbouni, A. (2016). Performance assessment of AquaCrop model for estimating evapotranspiration, soil water content and grain yield of winter wheat in Tensift Al Haouz (Morocco): Application to irrigation management. *Agricultural Water Management*, *163*, 219–235.

Vanuytrecht, E., Raes, D., Steduto, P., Hsiao, T. C., Fereres, E., Heng, L. K., Garcia, M. and Mejias, P. (2014). Environmental Modelling & Software AquaCrop: FAO ' s crop water productivity and yield response model. *Environmental Modelling and Software*, *62*, 351–360.

How to cite this article: V. Sai Pratyusha, Y. Siva Lakshmi, Guguloth Pragna, B. Apoorva, S. Rushyamee and Md. Salman Pasha (2022). Performance Evaluation of Aquacrop Model for Sweet Corn for Northern Telangana Zone. *Biological Forum – An International Journal, 14*(4a): 624-632.