Vulnerability assessment of *kharif* rainfed sorghum to climate change in SAT regions of India

K. BOOMIRAJ1, S. MARIMUTHU2, SUHAS P. WANI3, S. RAVIKUMAR4, MANIKANDAN3 and S. TANI5

1Agricultural Research Station, TNAU, Kovilpatti -628501, email: boomiraj@gmail.com
2Agricultural Research Station, TNAU, Bhavanisagar -638451, India
3International Crop Research Institute for Semi Arid Tropics, Patancheru, Hyderabad – 502324, India.
4National Research Center for Sorghum, Hyderabad – 500030. India
5Central Reserch Institute for Dryland Agriculture, Hyderabad – 500059. India

ABSTRACT

This paper presents results of Info Crop model evaluation in terms of its validation, sensitivity impact and adaptation of sorghum to climate change in semi arid tropics (SAT) regions of India. The model has reasonably predicted phenology, crop growth yield. Sorghum crop was found to be sensitive to changes in carbon dioxide (CO₂) and temperature. Future climate change scenario analysis showed that sorghum yields are likely to reduce at Akola, Anantpur, Coimbatore and Bijapur. At Kota the sorghum yield is likely to increase at 2020 and no change at 2050 and yield will reduce at 2080. The increase in yield at Gwalior and Kota at 2020 is due to reduction in maximum temperature and increase in rainfall from current. Adoption of adaptation measure like one irrigation (50mm) at 40-45 days after sowing would be better adaptation strategies for rainfed kharif sorghum with existing varieties in the selected location of the SAT regions.

*Keywords*: InfoCrop, simulation, validation, adaptation, dry matter, leaf area index, maturity, India, SAT.
Association analysis among morphological and physiological traits of grain yield in wheat and meteorological parameters

SHWETA AHLAWAT, ASHOK K CHHABRA, R.K.BEHL, O.P.BISHNOI, S.S.BISHT SAGARI BARAL and M.L.KHICHAR

Department of Genetics and Plant Breeding, CCS Haryana Agricultural University, Hisar 125 004, India

E mail: chhabra61@gmail.com, rkbehlprof@gmail.com

ABSTRACT

In order to identify potential traits determining yield under terminal heat stress during grain filling stages, correlation and path coefficients analyses were conducted to study character associations among 25 morphological and physiological traits in a set of genetically divergent 36 bread wheat genotypes under normal and late sown conditions. Grain yield depicted positive association with grain weight (GW), grains/spike (G/S), biological yield (BY), harvest index (HI) under normal (NS) and late sown (LS) conditions, GGR-3 (grain growth rate at 28 days after anthesis) in LS and negative association with DM (days to maturity), HU (heat units) and PTU (photothermal unit) in NS and with ChA-1(CHB “a” at anthesis), CHB “a”-1 (total CHB at anthesis) and CHB “a”-2 (total CHB at 28 days after anthesis) in LS. Path coefficient analysis revealed that out of eight characters significantly related to yield under normal sown conditions, PTU, harvest index, biological yield and grains per spike directly affected the grain yield in positive direction. On the basis of strong association with yield and marked direct influence on yield, the numbers of grains are considered to be first order yield components and ought to have top priority in selection under normal sown conditions. Under late sown conditions BY, harvest index (HI), CHB “a”-1 and grain weight had direct positive effect but the grains per spike exhibited negative direct effect despite of the fact that it possessed a positive significant correlation with grain yield. Based on results, it is suggested that high numbers of grains and high grain weight should be given priority for selection of high yielding genotypes in NS and LS, respectively.

Key words: Wheat, correlation, path coefficient, character association selection criteria, stay green, chlorophyll, grain yield,
Canopy reflectance spectra of wheat as related to crop yield, grain protein under different management practices

S. PRADHAN*, K.K. BANDYOPADHYAY and D.K. JOSHI

Division of Agricultural Physics, Indian Agricultural Research Institute, New Delhi – 110 012
*Corresponding author (sanatan28@gmail.com)

ABSTRACT

A field experiment was conducted during the winter season of 2010-2011 in a sandy loam soil at the Research Farm of the Indian Agricultural Research Institute, New Delhi, India to study the relationship of canopy reflectance with the yield and protein content of wheat as influenced by different irrigation and nitrogen levels. Three spectral reflectance indices (SRI) related to canopy photosynthetic area were calculated using spectral reflectance values viz., Red normalized difference vegetation index (RNDVI), Green normalized difference vegetation index (GNDVI) and Simple ratio (SR). The RNDVI, GNDVI and SR increased from Crown Root Initiation (CRI) to booting stage and thereafter decreased progressively till maturity. Among the three SRIs, GNDVI at milking stage was most closely related to grain yield \((r=0.97**)\) and biomass yield \((r= 0.93**)\) of wheat and at booting stage it was most closely related to the protein content \((r=0.90**)\). The GNDVI was the best index for prediction of grain yield, biomass yield and grain protein percentage in wheat.

Keywords: Yield, grain protein, RNDVI, GNDVI, SR, canopy reflectance
Simulation of maturity duration and productivity of two rice varieties under system of rice intensification using DSSAT v 4.5/CERES-Rice model

ANCHAL DASS*, AJIT SINGH NAIN, S. SUDHISHRI, and SUBHASH CHANDRA

G.B. Pant University of Agriculture & Technology, Pantnagar-263 145 (Uttarakhand)

ABSTRACT

Crop growth models have been considered as potential tools for simulating growth and yield of crops. Hence, Decision Support System for Agro-technology Transfer/Crop Estimation through Resource and Environment Synthesis (DSSAT v 4.5/CERES-Rice) model was applied to the data recorded in two years (2008 and 2009). The field experiment included two rice varieties (‘Pant Dhan 4’ and ‘Hybrid 6444’) cultivated with system of rice intensification (SRI) method, under three irrigation schedules (irrigation at 1, 3 and 5 day after disappearance of ponded water) and two planting spacings (20 cm x 20 cm and 25 cm x 25 cm). The model was calibrated using data of 2009 and validated with the data of 2008. For ‘Pant Dhan 4’ maturity was slightly under predicted (gap 2-6 days) by the model with an overall gap between observed and predicted values being 2%, during 2009. However, model predictions were closer (gap 1-2 days) during 2008. The predicted maturity of ‘Hybrid 6444’ was close to the observed one (gap 1 day) but it was over predicted for the year 2008. The model predicted the yield of both the varieties with fair accuracy. The overall gap between predicted and observed yield was 5% for ‘Pant Dhan 4’ and 11.4 % for ‘Hybrid 6444’. Hence the model can be used for predicting maturity and yield of these rice varieties grown with SRI method.

Key words: CERES-Rice, ‘Pant Dhan-4’, ‘Hybrid 6444’, irrigation, spacing, yield simulation
Simulating the phenology, growth and yield of aromatic rice cultivars using CERES-Rice model under different environments

M. SHAMIM*, A. M. SHEKH, VYAS PANDEY, H.R. PATEL and M. M. LUNAGARIA

Department of Agricultural Meteorology, Anand Agricultural University, Anand-388110, India

ABSTRACT

Field experiment were conducted during kharif seasons of 2007 and 2008 on silty loam soils of Nawagam under middle Gujarat Agroclimatic zone. Four aromatic cultivars of rice were transplanted on three dates to validate the CERES-Rice v.3.5 model. Highly positive significant association was found between simulated and observed days to heading ($r = 0.95^{**}$). The model overestimated biomass production under estimated test weight and LAI. The performance of the model in simulating grains per square meter was poor. The grain yield was simulated in close agreement with the field observed grain yield.

Key words: Simulation, validation, CERES-Rice model, aromatic rice
Trends in climate variability over Himachal Pradesh

RANBIR SINGH RANA, R. M. BHAGAT¹, MAN MOHAN SINGH², VAIBHAV KALIA, SHARDA SINGH and RAJENDER PRASAD³

Centre for Geo-Informatics Research and Training, CSK Himachal Pradesh Agricultural University, Palampur-176062
¹ Research and Development Coordinator Tocklai Experimental Station, Jorhat (Assam)
² IMD, Regional Meteorological Centre, Shimla
³ Department of Agronomy, CSKHPKV, Palampur

ABSTRACT

The study indicates warming signals in all the study sites except Shimla during 1969 to 87. The study indicated of higher than average signals of warming in Himachal Pradesh upland than lowland regions viz. Fatehpur and Palam Valley in recent decades. The data analyzed in terms of day and night temperature indicated that the warming was predominantly due to an increase in maximum temperature. The annual rainfall in all the regions experienced decreasing trends. The rainfall during rabi season found to be increased by 1.0 to 7.44 mm y⁻¹ in the regions receiving snowfall during winter months. The Palam and Kullu valley experienced decreasing trends in evaporation whereas relative humidity showed increasing trends at all elevations.

Key Words: Climate change indicators, temperature, rainfall, future scenarios, Himachal Pradesh
Climatic trends in Gujarat and its likely impact on different crops

M M LUNAGARIA, VYAS PANDEY and H R PATEL

Department of Agricultural Meteorology, AAU, Anand-388110, India
E-mail: mlunagaria@gmail.com

ABSTRACT

Maximum temperature, minimum temperature and rainfall of Anand, Junagadh, Mahuva, Navsari and SK Nagar stations of Gujarat were analyzed on seasonal (winter, summer, monsoon and post-monsoon) and annual time scales using long period data. Linear regression/least squares time series slope (parametric) and Theil-Sen slope (non-parametric) were used to investigate the trends of climate variability. Parametric and non-parametric trend analysis showed fair agreement in result except some cases where the non-parametric approach revealed very high magnitude in slope. During winter season minimum temperature is increasing and maximum temperature is decreasing at Junagadh. At Mahuva minimum temperature is decreasing and maximum temperature is increasing during summer. Only Anand station showed statistically significant increasing annual trend for minimum and maximum temperatures. There was no significant trend for any temperature time series of SK Nagar station. The rainfall of Saurashtra region (Junagadh and Mahuva) showed increasing trend. The impact of increasing temperature on different crops was found negative while decreasing temperature was found positive in most of crop studied.

Keywords: Trend, least squares, Theil-Sen approach, Mann-Kendall test, temperature, rainfall
Micrometeorological dynamics within mustard (*Brassica juncea*) crop canopy under semi-arid conditions of northern India

TARUN ADAK*1, GOPAL KUMAR2, BHASKAR NARJARY3 and N.V.K. CHAKRAVARTY4

1Division of Crop Production, CISH, Rehmankhera, Lucknow, Uttar Pradesh
2CSWCRTI, Regional Research Centre Vasad, Gujarat
3Division of Irrigation and Drainage Engineering, CSSRI, Karnal, Haryana
4Division of Agricultural Physics, IARI, New Delhi

*Corresponding author : e-mail: tarunadak@gmail.com

ABSTRACT

Field experiments were conducted for two years (2005-06 and 2006-07) at IARI, New Delhi, India research farm to assess the variations of micrometeorological parameters under differential hydrothermal regimes in mustard crop. Changes in sowing time and branch removal/defoliation treatments were imposed in order to create variations in hydrothermal regimes under phenology based irrigation scheduling. It was inferred that near-ground surfaces in the debranched plot where microenvironment was modified, air temperatures were higher (2 to 3 °C) as compared to control plots, decreased at 35 cm and remained almost similar with further increase in height at 1130 hrs while at 1430 hrs the magnitude of temperature variations was relatively higher. In contrast to air temperature, the relative humidity in debranched plot was less than that of the control plot. At near-ground, even at higher canopy height about 10% higher RH variations were observed in control plot as compared to debranched plot both in morning and afternoon hours. Furthermore, leaf area index could explain variations in temperature and RH to the tune of 40-50%. Radiation penetration and soil moisture depletion pattern also indicated significant impact of microclimatic variations near the ground.

Key Words: *Brassica juncea*; micrometeorology; soil temperature; radiation penetration
Incidence of insect pest damage in rice crop in relation to meteorological parameters in 
Punjab – A plant clinic data based case study

SUBASH SINGH, PRABHJYOT-KAUR1, VIJAY KUMAR and HARPREET SINGH1

Plant Clinic, Directorate of Extension Education
1 Department of Agricultural Meteorology, Punjab Agricultural University, Ludhiana – 141 004
email: prabhksidhu@gmail.com

ABSTRACT

The data incidence of insect pest of rice crop received at Plant Clinic, PAU Ludhiana during 2000-2009 were used to a study to analyse the effect of various meteorological parameters. Under Punjab conditions, maximum number (percent) of insect pest damage samples received at Plant Clinic were for plant hopper (44%) followed by leaf folder (30%) and stem borer (29%). The weather conditions conducive for the build up of rice pest population were cloudy weather coupled with a well distributed rainfall received in more number of rainy days during the crop season. Such conditions were observed during the high pest infestation years (pest samples >200) a well distributed (more number of rainy days) near or above normal rainfall was received during June to October, The climatic normals alongwith the interaction of rice crop, weather and insect population dynamics and these can be used as a tool for preparation of weather based agro-advisory.

Key words: Rice, insect pest, activity period, meteorological parameters, yield, crop-weather-insec.
Impact of weather variables on yield and yield attributes in Okra under different growing environments

S. K. DHANKHAR, D. P. DESWAL1 and SURENDER SINGH2

Department of Vegetable Science,
1Department of Seed Science and Technology
2Department of Agrometeorology

Ch. Charan Singh Haryana Agricultural University, Hisar -125004, India, Email: dhankharsk@gmail.com

ABSTRACT

Okra variety Hisar Unnat was sown on eight different dates during March to July of 2008 and 2009. Results revealed that high seed yield was obtained in okra sown on 15th June, 25th June and 5th July. Seeds per fruit, test weight and standard germination were also found superior during this period. Average relative humidity had significantly positive correlation with seed yield (r=0.76), number of seeds per fruit (r=0.72), test weight (r=0.79) and standard germination (r=0.79). Maximum, minimum and mean temperatures and evaporation expressed significantly negative association with above parameters. High seed yield of okra can be harvested, when maximum, minimum, and mean temperature remains around 33.5-36°C, 19.5-24°C, and 26.9-30°C, respectively with average relative humidity 65-75% and 4.1 -5.7 mm evaporation. Seed yield prediction would be more reliable when temperature, relative humidity and evaporation were taken together instead of individual weather variable in regression equation.

Key words: Weather parameters, okra, seed yield and quality
Influence of weather parameters on incidence of yellow vein mosaic virus in okra

SK DHANKHAR, PK CHOHAN and SURENDER SINGH1

Department of Vegetable Science, 1Department of Agri Meteorology
CCS Haryana Agricultural University, Hisar-125004, India
Email: dhankharsk@hau.ernet.in

ABSTRACT

Investigation was undertaken to find out influence of different weather parameters on incidence of YVMV disease in okra. Twelve okra genotypes were sown in randomized block design with three replications accommodating sixty plants of each genotype during rainy season of years 2007, 2008 and 2009. Incidence of YVMV disease was recorded at 30, 60 and 90 days after sowing in each genotype. Pooled data on per cent incidence of YVMV was subjected to correlation and regression analysis. Per cent incidence of YVMV disease was higher in 90 days old crop followed by 60 and 30 days old crops. Bright sunshine hours showed significantly positive association \( r = 0.94^{**} \) and minimum temperature showed significantly negative correlation \( r = -0.89^{**} \) with YVMV disease incidence. Morning relative humidity expressed positive correlation \( r = 0.14 \) whereas, evening relative humidity expressed negative correlation \( r = -0.61 \) with the disease incidence. All weather parameter except minimum temperature (78%) and bright sunshine hours (84%) expressed poor potential (below 2.0%) for the spread of the disease. However, when these parameters were taken together in the form of multiple regression equation, prediction potential was improved to the tune of 98%. Thus, most of the weather parameter in combination influenced the incidence of this disease. However, bright sunshine hours \( (9.0 \pm 0.5 \text{ hrs}) \) coupled with low night temperature \( (21.5 \pm 2^\circ\text{C}) \) played important role for the spread of YVMV disease in okra.

Key words: okra, yellow vein mosaic virus (YVMV), weather parameters
Predictive model for mustard aphid infestation for eastern plains of Rajasthan

B. BAPUJI RAO, A.P. RAMARAJ, C. CHATTOPADHYAY1, Y.G. PRASAD and V.U.M. RAO

Central Research Institute for Dryland Agriculture, Santhosh Nagar, Hyderabad – 500 059
1Indian Institute of Pulses Research, Kanpur, Uttar Pradesh.
E-mail: bapujirao@crida.ernet.in, bapujiraob2002@yahoo.com

ABSTRACT

An attempt has been made here to predict the appearance and development of aphids on mustard crop using data collected from a field experiment conducted during rabi seasons of 2001-2005 with c.v. Varuna and 10 dates of sowing. Minimum temperature and maximum temperature showed significant negative correlation whereas morning RH and rainfall showed positive correlation with aphid population. The afternoon relative humidity did not show any association with aphids. Aphid population build up, decline and thermal time were found to be non-linearly related. Functional relations with different lead periods involving maximum, minimum and mean temperatures were developed which may be utilized in the development of DSS for eastern plains of Rajasthan.

Key words: Mustard, aphids, prediction model.
Growth and yield prediction of wheat in relation to agroclimatic indices under irrigated and rainfed condition

MAHENDER SINGH and M.K.KHUSHU
Agro meteorological Research Station
Sher-e-Kashmir University of Agricultural Sciences & Technology-J
Main Campus, Chatha, Jammu- 180 009 (J & K).
msghanghas@yahoo.co.in, drmahendersingh@gmail.com

ABSTRACT

Field experiments were conducted during rabi season of 2005-06 and 2006-07 in irrigated as well as rainfed conditions under subtropical condition of Jammu with three cultivars (PBW-343, RSP-81 and Raj-3765) of wheat sown on normal dates of sowing with four replications. The different agroclimatic indices were derived at different phenophases. The results revealed that crop experienced 1670 oC day, 19584oC day hours and 10371oC day hours accumulated growing degree days (GDD), cumulative photothermal (PTU) and heliothermal units (HTU), respectively for attaining the maturity under irrigated conditions. The variety PBW 343 took higher thermal time (1602oC days) as compared to Raj 3765 (1576 oC days) and RSP81 (1574 oC days) for attaining physiological maturity. Maximum heat use efficiency (HUE) by variety PBW343 (5.87 kgha-1 oC days) was found under irrigated situation as compared to other cultivars. GDD was found best indices for prediction of phenology followed by PTU, HTU.

Key words: Wheat yield prediction, phenophases, agro climatic indices, rainfed & irrigated.
Thermal regime requirement and plant responses of chickpea cultivars under variable weather conditions

A.K. SINGH, A.N. MISHRA and PADMAKAR TRIPATHI

Department of Agricultural Meteorology
N.D. University of Agriculture & Technology, Kumarganj, Faizabad, (U.P.)

ABSTRACT

A field experiment was conducted during rabi season of 2006-07 and 2007-08 at Agromet Research Farm of N.D. University of Agriculture and Technology, Kumarganj, Faizabad with three chickpea cultivars viz. Awarodhi, Radhey and Uday grown under three dates of sowing. Results revealed that phasic duration and thermal unit from sowing to maturity decreased with successive delay in sowing. The accumulated thermal unit during the entire growth period of the crop decreased from 21370 days under October 31 sowing to 17850 days under late sowing (sowing delayed by 20 days). Number of pods and number of seeds per pod increased with increasing temperature from 9.1-23.5°C. Maximum temperature during reproductive stage had negative correlation on the yield. Yield decreased with successive increase of maximum temperature from 27.2-32.9°C.

Key words: Thermal, plant responses, cultivars, weather, yield attributes
Surface energy fluxes in wheat (Triticum aestivum L.) under irrigated ecosystem

JOYDEEP MUKHERJEE*, S.K. BAL, GURJOT SINGH, B.K. BHATTACHARYA1, HARPREET SINGH and PRABHJYOT KAUR

Punjab Agricultural University, Ludhiana 141 004
1Space Application Center, ISRO, Ahmedabad

ABSTRACT

The surface energy fluxes were measured over irrigated wheat during winter season. 2008-09 and 2009-10 sown on first week of November. Study revealed that the net radiation flux (Rn) varied from 420 to 693 W m⁻² during 2008-09 and 328 to 926 W m⁻² during 2009-10 in different growth stages. The soil heat flux was higher during initial and senescence growth stages (13 to 15 % of net radiations) as compared to peak crop growth stages (6 to 9 % of net radiations). The latent heat flux showed apparent correspondence with the growth which varied from 247 to 387 W m⁻² during 2008-09 and 209 to 569 W m⁻² during 2009-10 in different growth stages. Study revealed that LAI was positively related with intercepted photosynthetically active radiation (IPAR).

Key words: Energy balance, wheat, Bowen ratio, net radiations, latent heat flux
Long term trends in rainfall and its probability for crop planning in two districts of Bundelkhand region

SUCHIT K. RAI, PRADEEP BEHARI, SATYAPRIYA, A.K. RAI and R.K. AGRAWAL

Indian Grassland and Fodder Research Institute, Jhansi-284003, India
Corresponding author email: suchitrait@yahoo.co.in

ABSTRACT

Annual and weekly rainfall data for the period of 69 years (1942-2008) of Datia and (1939-2007) of Jalaun districts of Bundelkhand region were analyzed. The overall mean annual rainfall was 778.8 mm with 27.3% variability for Jalaun and 831.8 mm with 30.3 % variability for Datia region. Mann-Kendall rank statistics and Gaussian low pass filter revealed the long-term a decreasing trend in total amount of annual rainfall at Jalaun. However, in past 13 years (1996 to 2008), both regions exhibited significant decreasing trend in total amount of annual rainfall. At Datia, the probability more than 10 mm during 26th (25 June-1 July) and 27th (2-7, July) standard meteorological week (SMW) suggested to initiate field preparation operation for Kharif crop and sowing in subsequent week due to assured probability (70%) of more than 20 mm rainfall. The 27th and 28th (8-15, July) SMW is also an ideal time for the crop fertilization. Overall expected rainfall for getting more than 20 mm rainfall at 60% probability level is for 10 weeks at Datia suggesting that short duration varieties of various crops can be ideal in the region. At Jalaun, the trend analysis showed that field operation may be a week delay than Datia due to late onset on monsoon. Therefore, the ideal combination of crops of the regions may be sorghum for the grain purpose intercropped with cowpea for the fodder purpose as livestock is an integral part of rainfed rural economy.

Key words: Rainfall trend analysis, crop planning, rainfall probability, rainfed regions