Simulating the impact of climate change on growth and yield of wheat


Unit of Simulation & Informatics
Indian Agricultural Research Institute, New Delhi 110012

ABSTRACT

Under various climate change scenarios, the shifts in the optimal date of sowing of wheat for sustaining the wheat yields were evaluated for various agro-ecological regions by using wheat growth simulator, WTGROWS. Variability in the amounts of winter rains received could influence the rainfed wheat yields under normal weather as well as rising temperature (1-3 °C) situations. The results were different for different agro-ecological regions. The effect of winter season rainfall variability/change diminished as the soil moisture availability through irrigation amounts applied to the soil increased. Radiation–temperature interaction was seen through final above-ground biomass and grain yield at New Delhi and Patna environments. The differences were more significant in grain yield.

Key words: WTGROWS-model, wheat yield, climate change, sowing date
Journal of Agrometeorology 6 (1) : 9-16 (Jun 2004)

Estimating evapotranspiration of mustard and chickpea using remote sensing parameters

Y. V. SUBBA RAO, C.V.S. SASTRI and M. BHAVANARAYANA
Division of Agricultural Physics, IARI, New Delhi – 110 012

ABSTRACT

This paper presents an approach for estimating evapotranspiration (ET) in mustard and chickpea crops from remotely sensed data using the concept of Vegetation Index-Temperature Trapezoid (VITT) of Moran et al (1994). Field experiments were conducted with three irrigation treatments for obtaining a wide range of biophysical parameters and hence the ET values. From the spectral reflectance and canopy air temperature difference (CATD) measurements, ET was estimated and the water availability index (WI) was calculated and related to the biophysical parameters of the two crops. Results showed that the estimated ET values were in good agreement with the values obtained by modified Penman method using crop coefficients, thereby indicating that remote sensing data can provide a practical means of estimating crop ET (ETc) and there from the soil water status.

Keywords: Evapotranspiration, vegetation index, surface temperature, water availability index, remote sensing.
Evapotranspiration and crop coefficients for rice, wheat and pulses under shallow water table conditions of Tarai region of Uttarakhand

R.P. TRIPATHI
Department of Soil Science, G. B. Pant University of Agriculture and Technology
Pantnagar - 263145, Uttarakhand

ABSTRACT

Water table contribution, evapotranspiration (ET) and crop coefficients for rice (Oryza Sativa L.), wheat (Triticum aestivum L.) and three winter pulses viz. chickpea (Cicer arietinum L.), fieldpea (Pisum sativum L.), and lentil (Lens culinaris medic.) were determined under shallow water table conditions using lysimeters. The 3-year average percolation (Pc) and ET of rice was 635 and 655 mm from clay loam, 675 and 668 mm from silty clay loam, and 693 and 680 mm from loam, respectively. Similarly average ET of wheat crop was 411 mm, and that of chickpea, fieldpea and lentil was 370, 362 and 352 mm, respectively. A high ET was associated with low yield under shallower than deeper water tables.

Average water table contribution (WTc) was 78.6, 65.5 and 38.5 percent of ET of wheat crop over the water table at 0.6, 1.0, and 1.6 m depths, respectively. Similarly average WTc to the ET of the three-pulse crops was 89 ± 0.8, 66.8 ± 2.1, and 47.3 ± 2.4 percent from the water tables at 0.6, 1.0 and 1.6 m depths, respectively. The WTc was highest in chickpea and lowest in lentil. The crop coefficient (Kc), calculated as ratio of measured ET to potential ET by Jensen-Haise method, was 1.0 to 1.7 for rice during 24-66 days from transplanting, 1.0 to 1.07 for wheat during 65-90 days from sowing and 1.0 to 1.1 for the 3 pulse crops during 70-128 days from sowing. A fifth degree polynomial with highly significant R² fitted the data.

Key words: Chickpea, crop coefficient, evapotranspiration, fieldpea, lentil, rice, water table contribution, wheat.
Effect of tillage and irrigation on solar radiation interception, leaf water potential and productivity of wheat in rice based cropping system

R.K.TOMAR, K.S.GANGWAR¹, D.SINGH¹, R.N.GARG, V.K.GUPTA, R.N.Sahoo and R.PARORA
Division of Agricultural Physics
Indian Agricultural Research Institute, New Delhi-110012
¹ Project Directorate for Cropping Systems Research, Modipuram, Meerut-250110

ABSTRACT

Field experiments were conducted in sandy loam well drained alluvial Typic Ustochrept soils at Modipuram, Meerut (UP) to study the influence of levels of tillage and irrigation schedules on interception of solar radiation components, leaf water potential (LWP) and productivity of wheat in rice-based cropping system during (1997-98). The field was continuously under rice-wheat rotation during 1994-95 to 1997-98. Substantially higher radiation was intercepted under direct seeded as compared to puddled condition. Lower LWPs (pre-dawn and mid-day) were found under direct seeded as compared to puddled conditions. Levels of tillage as well as irrigation schedules have significantly influenced the grain yield and total harvestable biomass. The results indicate the adverse effect of puddling practices adopted in preceding rice crop on the succeeding crop of wheat in the system.

Key Words: PAR, radiant energy, light intensity, leaf water potential, tillage, rice-wheat system

Water and thermal use characteristics of cowpea (Vigna unguiculata L. Walp.)

A. S. RAO and R. S. SINGH
Central Arid Zone Research Institute, Jodhpur - 342 003

ABSTRACT

The evapotranspiration rates of unstressed cowpea (Vigna unguiculata L. Walp. cv. Charodi-1) as measured from gravimetric lysimeters in the arid region of Jodhpur during 1999 to 2001 were 2.8-3.7 mm day\(^{-1}\) during early growth, 3.7-6.8 mm day\(^{-1}\) at vegetative stage, 4.1-6.6 mm day\(^{-1}\) at flowering/pod filling stage and 3.1-4.0 mm day\(^{-1}\) at maturity stage. The seasonal evapotranspiration of cowpea was 312 mm with an average yield of 1362 kg ha\(^{-1}\) resulting a water-use efficiency of 4.36 kg ha\(^{-1}\) mm\(^{-1}\). The crop coefficients increased from 0.50 at early growth stage to 1.19 at vegetative stage and declined to 0.54 on maturity. The thermal time requirements, energy balance and advection were also quantified.

Key words: Cowpea, evapotranspiration, irrigation, water-use efficiency, advection, arid region
Drought in Gujarat districts and state as key indicators to all India drought

P.G. GORE and A.S. PONKSHE
India Meteorological Department, Pune – 411005.

ABSTRACT

Drought is a frequent phenomenon over the Gujarat state. ‘key’ areas in Gujarat to which highest probabilities of spatial coherence of occurrence of drought are associated with individual districts, with state and with country, during the period 1901-2000 have been identified using rainfall departure from the normal.

Major parts of Saurashtra and Kutch region have high probabilities of spatial coherence of drought with state level drought occurrence. Bulsar district has highest probability of 59% for spatial coherence of drought with All India drought. Within the Gujarat state, the spatial extent of drought is the highest (in 94% of the districts) with Broach and Surat taken as ‘key’ districts.

Key Words: Drought, coherence, probability, ‘key’ areas.
Effect of thermal regime on growth and development of Indian Brassicas

RAJ SINGH, V.U.M. RAO and DIWAN SINGH
Department of Agricultural Meteorology, CCS HAU, Hisar - 125 004

ABSTRACT

Field experiments were conducted during rabi seasons of 1996-97 and 1997-98 at research farm of C.C.S HAU, Hisar, to study the effect of thermal regime on growth and development of Indian brassicas. A difference in the accumulated thermal units during various phenophases of the cultivars of Brassica juncea and Brassica campestris was seen. In late sown crop, the higher day and night temperatures during reproductive phase led in forced maturity and reduced time to maturity. Accumulated thermal units had a close relationship between LAI and dry matter accumulation. During grand growth phase, the dry matter had accumulated in geometric progression. Seed yield and numbers of siligua/m² followed the parabolic growth function, whereas 1000-seed weight showed a sigmoid pattern with thermal units.

Key Words: Drought, coherence, probability, Key areas.
Relevance of thermal units in deciding sowing time and yield prediction of groundnut (*Arachis hypogaea* L.) under irrigated condition of western Rajasthan

R.P. MEENA and A.K. DAHAMA
Agricultural Research Station, Rajasthan Agricultural University, Bikaner-334006

**ABSTRACT**

Experiment was conducted for two years from 1998 to 1999 on loamy sand soil at Agricultural Research Station, Beechwal, Bikaner (Western Rajasthan) to study the relevance of thermal units with respect to sowing time and pod yield prediction of irrigated groundnut (*Arachis hypogaea* L.). Pod yield and biomass production were the highest for the 15th March and 1st April sowing dates followed by a progressive decrease in later dates of sowing. The pod yield was positively correlated with heat use efficiency (HUE), heat unit (HU) and photothermal units (PTU) from flower initiation to maturity phenophase ($R^2$) ranged from 0.913 to 0.989.

**Key Words:** Groundnut, heat units, sowing time
Radiation use efficiency of mustard cultivars under different sowing dates

S.S. HUNDAL, PRABHJYOT-KAUR and S.D.S. MALIKPURI
Department of Agronomy & Agrometeorology
Punjab Agricultural University, Ludhiana – 141 004

ABSTRACT

Field experiments were conducted at Ludhiana to determine cultivar and sowing date effects on radiation use efficiency (RUE) and crop growth rate (CGR) in mustard. Two mustard cultivars viz: Bio-902 and Pusa-Bold were sown on different dates during two consecutive rabi seasons of 1999-2000 and 2000-2001. CGR computed for different crop growth intervals revealed peak CGR of 33.7 and 30.4 g m\(^2\) day\(^{-1}\) for Bio-902 and Pusa-bold, respectively sown in first week of November. The highest RUE of 2.44 g MJ\(^{-1}\) for dry matter accumulation and 0.62 g MJ\(^{-1}\) for seed yield were recorded when the crop was sown in third week of October. Significant linear regression relationship (R\(^2\) = 0.89) was observed between total dry matter accumulation and cumulative photo synthetically active radiation (PAR).

Key words: Mustard, RUE, CGR, PAR, Brassica.
Agroclimatic analogues of rice (*Oryza savita* L) and sugarcane (*Saccharum officinarum* L) in Assam

P. GOGOI KHANIKAR and K. K. NATH
Department of Agrometeorology, Assam Agricultural University, Jorhat, Assam

ABSTRACT

Soil climatic analogous areas for rice (*sali* & *ahu*) and sugarcane have been carved out in Assam by superimposing monthly rainfall and mean temperature maps on soil suitability maps of the respective crops. The analogous zones for the crops have been categorized as 'most suitable', 'suitable', 'fairly suitable', and 'unsuitable' depending on degree of suitability of the zones for the crops. It is seen that *Sali* & *Ahu* rice can be grown almost throughout the state except the flood prone/affected as well as the well drained upland areas. Sugarcane can be cultivated in all the regions of the state except flood prone/affected or low land waterlogged areas. These analogous maps will help to suggest viable and beneficial cropping patterns in the state through replacement of crops by more efficient ones thereby enhancing the productivity of these crops.

**Key words**: Climatic analogues, soil suitability, *Sali* rice, *Ahu* rice, and sugarcane.
Calibration and application of the ‘SOYGRO’ - model to predict growth and yield of soybean in Punjab

PRABHJYOT-KAUR, HARPREET SINGH and S.S. HUNDAL
Department of Agronomy and Agrometeorology
Punjab Agricultural University, Ludhiana-141004

ABSTRACT

The dynamic simulation model 'SOYGRO' was used to predict soybean growth and yield from 1997 to 1999 at Ludhiana for the commonly grown cultivars, PK-416 and SL-295. The simulated phenologic events showed deviations of -5 to +10 days for flowering, -3 to +10 days for first pod, -11 to +2 days for full pod and -6 to +4 days for physiological maturity of the crop. The model predicted the seed yield to be within 98-124% and pod yield to be within 75-111% of the observed values. The results obtained with the model for the three consecutive crop seasons revealed satisfactory prediction (except for 1999 season) of phenology, growth and yield of soybean.

Keywords: Crop modeling, SOYGRO, CERES, Soybean
Rainfall distribution pattern of Cuttack and its implication in rainfed rice and other crop planning for coastal Orissa

SANJOY SAHA, G.C. BISWAL and B. N. SINGH
Central Rice Research Institute, Cuttack – 753006, Orissa

ABSTRACT

Daily rainfall data of 60 years (1941–2000) recorded in the ‘Agromet observatory’ of the Central Rice Research Institute, Cuttack were examined for establishing the long term averages of annual and seasonal rainfall and its temporal variability. Average annual rainfall of this region was 1536 mm. Coefficient of variability of annual rainfall (21%) indicated that the rainfall was more or less stable over the years. At 25 and 50% probabilities, the stable quantum of rainfall was observed during 24th–41st and 25th–38th standard meteorological week (SMW), respectively. The probabilities of receiving 10, 15 and 20 mm of average weekly rainfall exceeded 70% from 23rd–42nd, 24th–41st and 25th–40th SMW, respectively. There is an ample opportunity to harvest the excess rain water during the period of July – September which can be utilized as life saving irrigation or utilized for raising a second crop of short duration pulses or oilseeds.

Key Words: Rainfall pattern, rainfed rice, crop planning
Climatic characterisation of crop productivity and input-needs for agrometeorological advisory services*

S. VENKATARAMAN
59/19, Navsahyadri Society, Pune - 411052.

ABSTRACT

The complex nature of characterising climate in terms of crop productivity is brought out. The need for (i) delineation of crop-climate zones (ii) demarcation of homogenous rainfall zones and (iii) identification of endemic areas and periods for major pests and diseases for assessing productivity potential of various areas under dryland and irrigated farming is highlighted. The usefulness of agrometeorological analyses in the unification of apparently diverse data on development, water needs and pest and disease afflictions of crops is pointed out paragraph.

The need for agromet advisories and input requirements for agromet advice on (i) field operations (ii) assessment of crop prospects and yield (ii) regular and supplementary irrigation and (iii) combating incidence of pests and diseases and adverse weather are mentioned. Intricacies involved in crop-drought warnings and crop yield forecasts are pointed out. Some areas for research in (a) long and medium range weather forecasting (b) space-based remote sensing and (c) use of crop-weather models are indicated. The coordination required for real-time agromet advisory work is spelt out.

Keywords: Yield per day, crop-climate, phytometeorology, crop-weather services
Cross calibration of leaf area index measurements by canopy analyzer and line quantum sensor over wheat crop

H.S. RAJPUROHIT, A.S. NAIN, B.K.BHATTACHARYA, M.R. PANDYA and V.K.DADHWAL
Crop Inventory and Modelling Division, Agricultural Resources Group, Space Applications Centre (ISRO), Ahmedabad – 380 015

ABSTRACT

Studies were carried out at 28 locations in farmers' fields of wheat crop during rabi season of 2000-2001 within a stretch of 15 km surrounding Chharodi Agricultural Research Farm of Gujarat Agricultural University to measure and cross calibrate green leaf area index (LAI) at maximum tillering and grain filling stages of wheat, separately by line quantum sensor (SS-1 type) and field calibrated canopy analyzer (LAI-2000). Both the pooled and individual datasets for different crop growth stages were utilized for cross calibration of line quantum sensor (SS-1 type) with respect to canopy analyzer. Leaf area index values were found to range from 0.9 to 6.0 at different growth stages of wheat. Linear regression relations with high $R^2$ values were found to exist in case of pooled dataset ($Y = 0.876X + 0.357$) as well as individual datasets.

Key words: Leaf area index, plant canopy analyzer, line quantum sensor
Forecasts of groundnut yield using rainfall variables for Saurashtra region of Gujarat state*


College of Agriculture, Gujarat Agricultural University,
Junagadh - 362 001

ABSTRACT

Preharvest forecast models for groundnut yield using 25 years (1971-1995) rainfall data were developed for five major groundnut growing districts of Gujarat state. The regression equations incorporating phenophase rainfall suggested that the flowering & peg initiation were the most critical stages in respect of moisture requirement of groundnut. Preharvest forecasting of groundnut yield could be done at the earliest in second week of August (13-19 Aug.) for Junagadh and Amreli, second week of September (10-16 Sept.) for Bhavnagar and Rajkot, and fourth week of September (24 - 30 Sept.) for Jamnagar district.

Key words: Preharvest forecasting, groundnut yield, Saurashtra region.
Spatio-temporal changes in area, production and productivity of rapeseed and mustard in Haryana*

DIWAN SINGH, K.K. PAHADIA and V.U.M. RAO
Department of Agricultural Meteorology, CCS HAU, Hisar-125004, Haryana (India)

ABSTRACT

A study was conducted to know the shift in the spread, production and productivity of rapeseed and mustard in Haryana during the three pentads comprising the recent past one and half decades (1979-80 to 1993-94). A significant increase in the area under the crop was noticed in the districts of Mahendergarh, Rohtak, Bhiwani, Gurgaon, Faridabad, Jind, Hisar and Sirsa. However in the districts of Ambala, Karnal and Kurukshetra a decline in area under the crop was noticed during the last two pentads. Almost similar trend was observed for the production of crop in the state. The increase in both area and production was more spectacular in the pentad comprising the period between 1989-90 to 1993-94 as compared to the previous two pentads. A striking feature of the study was that the increase in production was not solely because of the increase in area, but the improved productivity also contributed equally.

Keywords: Mustard, area production, Haryana