AICRPAM

At a glance

All India Coordinated Research Project on Agrometeorology

Central Research Institute
for Dryland Agriculture
Santosh Nagar
Hyderabad-500 059

ALL INDIA COORDINATED RESEARCH PROJECT ON AGROMETEOROLOGY (AICRPAM) AT A GLANCE

BACKGROUND

Inter-annual variations in food grain production are still continuing in the country due to aberrant weather conditions in India despite technological advances made by ICAR and SAUs.

With an aim to bring stability in food grain production in the face of varying weather conditions, Government of India recognized the importance of agrometeorology and started strengthening it at its various Research Institutes functioning under ICAR. The National Commission on Agriculture (NCA) (1976) strongly recommended for establishment of Departments of Agricultural Meteorology at each State Agricultural University for strengthening teaching and research in Agricultural Meteorology. The inception of All India Coordinated Research Project on Agrometeorology during 1983 at CRIDA, Hyderabad was the culmination of the prompt response of ICAR to the recommendations of NCA.

MILESTONES

- In the year 1983, ICAR formally launched All India Coordinated Research Project on Agrometeorology (AICRPAM) with its Coordinating unit at Central Research Institute for Dryland Agriculture (CRIDA), Hyderabad and 10 Cooperating Centres at different State Agricultural Universities across the country.
- During VII Plan period, i.e., during 1988 to1989 two more centres, were added to the network raising the total to 12.
- Indo-US Sub-project on "Strengthening Agrometeorological Research to enhance Food Production" initiated in 1988. Under this programme, Project was given necessary impetus and vital boost for initiating research work in AICRPAM. Indo-US collaboration facilitated to equip the Cooperating Centres with modern agrometeorological instruments and also provided specialized training to the scientists of the project in USA on identified thrust areas.
- Impressed by the good progress made by AICRPAM, ICAR sanctioned 13 more new centres during VIII Plan (1995 - 96) totalling the number of centres to 25.
- Since 1990, of the project started issuing weather-based agro-advisories in collaboraation with NCMRWF.
- A national level Agromet Databank was established in 1998 with the financial support from DST to cater to the needs of agromet data requirement of ICAR Institutes and other organisations.
- Launching of website www.cropweatheroutlook.ernet.in in the year 2003 paved the way for dissemination of agro-advisories to reach larger public, including farmers, researchers, planners etc.
- For strengthening of research capabilities of Agrometeorologists, about 22 training programs were conducted.

About the Project

The Project maintains its uniqueness among other network projects by not confining to a single commodity or crop and a particular ecosystem or climatic condition. The research domain of the project cuts across all the four agro-ecosystems, viz., Rainfed, Irrigated, Hill & Mountain and Coastal Island. Unlike other Network Project on Agrometeorology elsewhere in the world, which are mostly focused on data collection and operational research, it is engaged in both basic and operational research. Each centre conducts agrometeorological research on one or two main crops of its region besides analyzing long-term weather data for Agroclimatic Characterization and Climate Change Studies. Bi-weekly Agro Advisory Services (AAS) using the research results obtained over the years are disseminated through its website. The Cooperating Centres are also conducting awareness programs on climate change related issues among the farming community through special programs. The project is being operated with the support of 111 members, including 37 scientists, 62 technical and 12 administrative staff.

Objectives

- To study the agricultural climate in relation to crop planning and assessment of crop production potentials in

different agroclimatic regions,

- To establish crop-weather relationships for all the major rainfed and irrigated crops in different agroclimatic regions,
- To evaluate different techniques of modification of crop micro-climate for improving water use efficiency and productivity of the crops,
- To study the influence of weather on the incidence and spread of pests and diseases of field crops,
- To provide weather-based agro advisories using medium range weather forecast and ICT,
- To collect and update weather date in the Agromet Databank at CRIDA.

The above objectives are pursued through following themes.

- Agroclimatic Characterization
- Crop-Weather Relationships
- Crop-Weather Modelling
- Effect of Weather on Pests and Diseases
- Agro Advisory Services

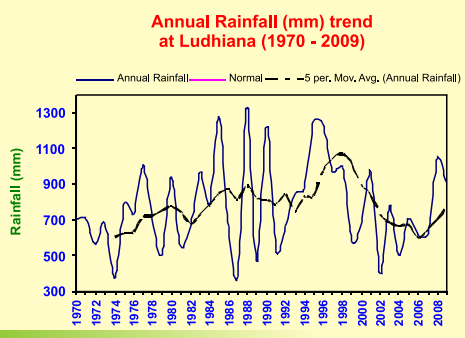
Theme-wise achievements emerged from the research activities over years are summarized as under:

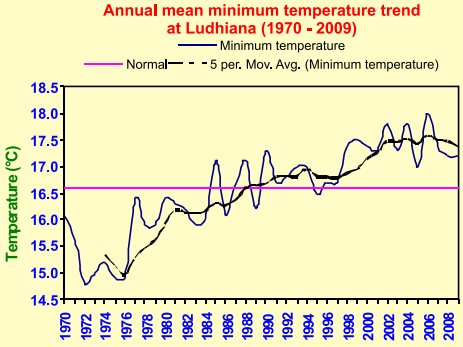
Agroclimatic Characterization

- Climatic resources of many agroclimatic regions were worked out for better agricultural planning and agroclimatic Atlases were brought out by centres Anand, Raipur and Faizabad.
- The probabilities of weekly and monthly rainfall occurrence were worked out by many centres and Nakshatra-wise probabilities were also worked out by few centres for easy understanding of farmers.
- Crop growing environments for mustard, pearlmillet, chickpea, cashew, cardamom and groundnut were delineated.
- The frequency of occurrence of droughts and their impact on agricultural production was studied by few centres. Reduction in yield under various intensities of drought (25 Years data) at Solapur are as follows:

Drought type	Average yield (kg ha-1)	Yield reduction (%)
No drought	2042	-
Mild	1619	20
Moderate	1006	51
Severe	745	64

- Climatic variability and trends in different weather parameters were assessed at all the research centres.
- Observation on VUB radiation was initiated at few centres.





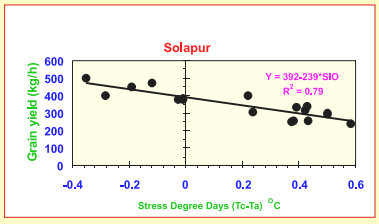
Crop-Weather Relationships

- At Raipur, wheat varieties tolerant to thermal stress were identified with the help of Thermal Sensitivity Index (TSI). The results showed that genotypes Arpa and Lok-1 are moderately sensitive and rest of the varieties Kanchan, Sujata, Bilasa, HD-2189, HI-1077 and GW-273 are sensitive to thermal stress, therefore, not suitable for late sowing conditions.

- Based on line source irrigation experiments in mustard at Anand, it was recommended to apply four irrigations each of 30 mm through sprinkler for obtaining optimum yield in middle Gujarat agroclimatic zone. In this zone, higher day length and temperature during vegetative phase and cooler temperatures (< 19˚C) during reproductive period were found to be optimum weather conditions for higher yield.

- Response farming strategies for overcoming adverse effects of early and late season droughts in pearlmillet at Solapur, proved that in-situ moisture conservation practice of "ridges and furrows before sowing" was better over other drought management practices.

- At Solapur, crop water use can be effectively monitored and yield of pearlmillet could be accurately estimated with the help of canopy temperature differential.

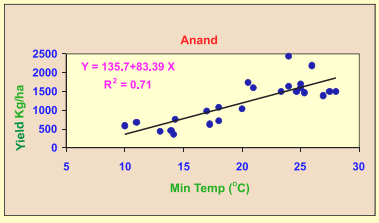


Relation between stress degree days and grain yield of pearlmillet at Solapur

- At Mohanpur rainfall during 100 percent anthesis to maturity showed significant positive relationship with rice yield and is crucial for achieving higher yield.

$$Y = 1294 + 5.8\ RF \qquad R^2 = 0.95$$

- At Anantapur, a dry spell of more than 15 days duration during pod filling stage was identified as climatic risk in rainfed groundnut, as it reduced yield by 60-75 percent.



Relation between minimum temperature and pod yield of groundnut at Anand

- Significant positive relationship between minimum temperature and pod yield in groundnut were observed at Anand, Anantapur, Ludhiana and Bangalore. At Anand, minimum temperature around 23-25˚C during pod development stage favoured in achieving higher pod yield. At Anantapur and Ludhiana, drop in nigh temperature below 20˚C adversely affected the growth and yield of groundnut.

- Based on long-term (1976-1996) yield data of fingermillet (Indaf-8) under different sowing windows and the corresponding rainfall during the crop growing period at Bangalore, sowing window period 9 July to 5 August was identified to be the best for obtaining high yield.

- The analysis of rice yield in relation to weather parameters at Dapoli reveals that sunshine hour is the major weather parameter for achieving higher grain and straw yields and also higher harvest index. Therefore, sowing of crop 20 days after the onset of monsoon seems to be optimum period for getting higher grain and straw yields as increased number of sunshine hours during maturity helped in increasing the productivity.

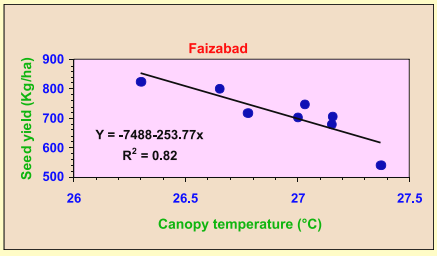
- Crop water requirement in different growth stages as well as total growing period were worked out for all important crops, viz., rice, wheat, maize, sorghum, pearlmillet ,finger millat, soybean, groundnut, mustard, cotton and gram.

- At Anand, 1˚C increase in minimum temperature in the month of December and January reduced the wheat yield by 217 and 404 kg/ha, respectively.

- Thermal sensitivity of mustard varieties were evaluated at Raipur and identified Pusa Gold and T-9 as susceptible and Pusa Bold and Pusa Agrani as moderately susceptible to thermal stress.
- At Mohanpur, seed yield of mustard showed highly significant positive relation (R^2 = 0.98) with radiation during the growing period.
- Yield of sunflower at Solapur showed significant positive relationship with cumulative moisture use and photosynthetically active radiation (PAR) during the total growing period. Unit increase in moisture use produced 2.3 kg/ha more yields.
- At Kovilpatti, rainfall during the growing period showed significant positive relationship with yield of rabi sorghum.

Station	Crop	Crop water requirement (mm)
Solapur	Pearl millet	250
	Gram	210
Raipur	Wheat	467
	Rice	725
	Soybean	667
Rakh Dhiansar	Groundnut	494
	Maize	491-561
	Wheat	274
	Mustard	301
Kovilpatti	Sorghum	380
	Cotton	310
Ranchi	Fingermillet	288

- The relationship between cardamom productivity in Kerala and water deficit during summer was worked out by Thrissur.
- Potato yield at Mohanpur showed inverse relationship with air temperature during planting to ripening stage and soil temperature (at 15 cm) during tuberization to end of bulking stage.
- Yield of chickpea at Jabalpur showed significant negative relationship with temperature during reproductive period. Increase in temperature by 1°C during reproductive period caused yield loss of 82 kg/ha.
- At Ranichauri, minimum temperature less than 10°C during grain filling and maturity stages reduced seed yield of amaranthus.
- Based on agrometeorological studies, Bhogali and Monohar Sali varieties of rice were identified for delayed transplanting conditions at Jorhat.
- At Ludhiana, water production functions were developed for wheat, raya, gram, sunflower, soybean, groundnut and greengram.



Relationship of canopy temperature and yield in mustard at Faizabad

- Yield of mustard at Faizabad and cotton yield at Kovilpatti showed significant inverse relationship with canopy temperature, under rainfed conditions.
- At Bijapur, a multiple regression equation relating yield of pearlmillet with weather parameters, viz., maximum temperature at 3 and 6 week (TX_3 and TX_6) and cloud cover at 8 and 9 week (CC 8 and CC9) was developed.

$$Y = 47.4\ TX_3 - 110.6\ TX_6 + 233.7\ CC8 + 236\ CC9 + 207\ R^2 = 0.66$$

This model can provide yield forecast 3 to 4 week in advance of harvest.

- At Hisar, the decrease in seed yield of mustard was of the order of 4.4 q/ha for every 1°C rise in minimum temperature during seed development period.

$$Y = 51.2 - 4.4X \qquad R^2 = 0.89$$

- At Parbhani, weather during milk stage showed highly significant relationship with yield of kharif sorghum.
- At Palampur, Crop Weather Calender for maize and rice crops were prepared.
- At Ludhiana, based on microclimatic studies, it was recommended to decrease the row spacing to 15 cm from the existing practice of 22.5 cm row spacing in wheat crop, in view of the increase of 13 percent increase in yield.
- Analysis of data on phenology of mustard (cv. Varuna) pooled over three locations, viz., Hisar, Arjia and Mohanpur, in relation to temperature showed that duration of both vegetative and reproductive phases is inversely related to average temperature. Increase in temperature by 1°C reduced the vegetative period by 3 days and reproductive

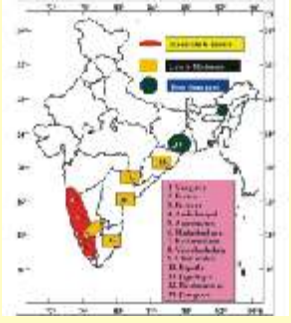
period by 6 days across the stations. Over all thelocations, increase in duration by one day improves yield by 32.8 kg/ha and increase in temperature by 1˚C reduces yield by 174 kg/ha.

Crop Growth Modelling

- Centres have validated process-based crop simulation models, viz., DSSAT, PEANUTGRO, BRASSICA, CERES, and RODMOD, for major crops like rice, wheat, sorghum, groundnut, soybean and mustard.
- Sensitivity analysis of models like INFOCROP, WHEATGRO, etc. was worked out by comparing predicted values with observed ones.
- Large database on phenology dry matter partitioning and GDD requirement of many crops, viz., rice, wheat, maize, sorghum, pearlmillet, fingermillet, pigeonpea, chickpea, soybean, cotton, groundnut, greengram, mustard, sunflower, safflower and amaranthus was generated.
- Statistical models using long-term crop and weather data and their validation were carried out.

Weather Effects on Pests and Diseases

- Using long-term experimental data, regression models for forecasting bacterial leaf spot in grapes , powdery mildew incidence in ber and DSS for pest management was developed at Bijapur.
- Kovilpatti centre has identified the periods of outbreak of bacterial blight disease in cotton from the historical disease and weather data and suggested contingency plans for spraying of chemicals.
- A multiple regression equations using temperature, relative humidity, wind direction and evaporation was developed for prediction of Helicoverpa armigera population in cotton crop at Hisar.
- The hotspot areas of tea mosquito bug across the cashew cultivated regions of the country were demarcated considering optimum night temperatures during flushing and flowering stage by Thrissur centre.



Hot spot area of Tea Mosquito Bug (TMB) in cashew

- At Hisar, low mean temperature and high relative humidity were identified to be causing increase in aphids population in mustatd.
- At Solapur, fall in minimum temperatures to 15˚C with low morning relative humidity (< 60%) led to sugary secretion in rabi sorghum, further fall in minimum temperature to less than 12˚C lead to severe sugary secretion.
- At Anand, maximum temperature of more than 32˚C favoured infestation of stem rot and where maximum temperature range between 26-28˚C and relative humidity of 82-86 percent favoured infestation of white rust in mustard.
- At Faizabad, thumb rules were developed for incidence of *alternaria leaf blight* in wheat:

Weather condition	Percentage disease intensity
Maximum and minimum temperature above normal and RH below normal	High
Maximum and minimum temperature below normal and RH above normal	Low

- At Palampur, RH of about 90 percent, night temperature less than 20˚C and cloudy conditions were conducive for development of blast disease in rice.
- Weather conditions identified to be conducive for development of insect pests of rice crop at Mohanpur are:

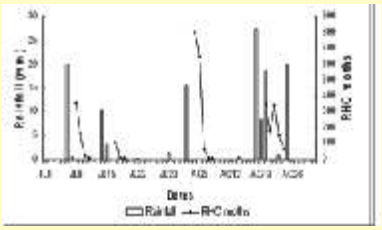
  Tmax = 34-35˚C, Tmin 24-27˚C, RH1 = 90-99%, RH2 = 67-81% (Leaf folder)

  Tmax = 32-35˚C, Tmin 24-26˚C, RH1 = 96-99%, RH2 = 75-81% (Rice hispa)
- At anantapur centre, close relation between emergence of red hairy caterpillar (RHC) in groundnut and heavy rainfall events was observed. RHC reach a peak, 3 to 4 days after rain event.

- At Bangalore, regression equations relating tikka disease in groundnut and weather conditions, i.e., relative humidity (RH), growing degree days (GDD) and sunshine hours (SSH) was developed as follows:

  $$\text{Tikka}\ (\%) = 654\ 8.9\,RH\ 0.17\,GDD + 0.54\,SSH \qquad R^2 = 0.91$$

- Based on data for 12 seasons, minimum temperature, relative humidity during soft dough stage, number of rainy days and rainfall from sowing to harvest in wheat were identified as factors responsible for incidence and spread of Karnal bunt disease at Hisar.

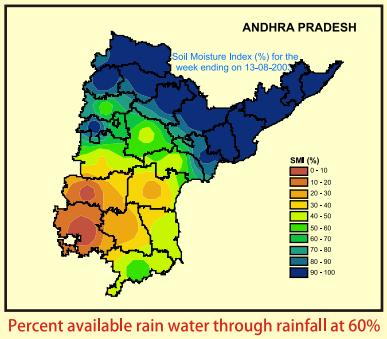


Relation between number of RHC moths and rainfall duringJuly and August at Anantapur

Activities at Coordinating Unit

- A website www.cropweatheroutlook.ernet.in was developed at Coordinating Unit (CRIDA) for better dissemination of weather-based agro-advisories prepared at Cooperating Centres of Project.
- In this website, weekly crop contingency plans for rainfed regions at the country level are provided and the website has been hyperlinked to ICAR website at Headquarters.
- Reliability of long-term forecast of rainfall in southwest monsoon issued by IMD was tested for different meteorological sub-divisions. The reliability of deficit rainfall forecast was very high in northwest region (Gujarat, Rajasthan and parts of Western Uttar Pradesh) and excess rainfall forecast was more valid in east Rajasthan, eastern Uttar Pradesh, eastern Madhya Pradesh, Chhattisgarh, etc.

- Estimates of All India food grain production, well in advance of harvesting, was made using monthly rainfall indices during the monsoon season and southern Oscillation Index values.
- With the help of block level daily rainfall, crop statistics and soil information, climatic constraints for low productivity of rice in eastern India were identified.
- "Thematic maps of weekly rainfall and temperature departures as well as soil moisture index (SMI) maps were prepared for preparing contingent crop plans in A.P.
- Climate Database Management project. Spatial distribution maps of monthly weather parameters, viz., maximum and minimum temperature and rainfall and those of derived indices, aridity index and moisture adequacy index during monsoon was developed.
- Under the project "Development of weather-based forewarning systems for crop pests and diseases", crop-pest-disease-weather relationships were developed for 14 targeted insect pests and 12 diseases in six crops. Simple weather-based thumb rules for forewarning of pests / diseases were developed and validated. A decision support model for leaf spot in groundnut, a degree-day model for aphids in mustard and neural network model for yellow stem borer in rice and American boll worm in cotton were developed.
- Farmers awareness on climate and its change was analysed based on the feed received from the farmers in different regions of the country.
- A weather based DSS for growing *Kharif* in Telengana region was developed.



Percent available rain water through rainfall at 60% probability for rainfed rice in Eastern India

- Under the ongoing Network Project on "Climate Change", annual rainfall data of 1140 stations in rainfed districts of the country were analyzed and regions vulnerable to climate change were identified. The impacts of climate change on crop water requirement and length of growing season of wheat in Indo-Gangetic Plains and on yield of major crops in other regions were studied.

Trainings

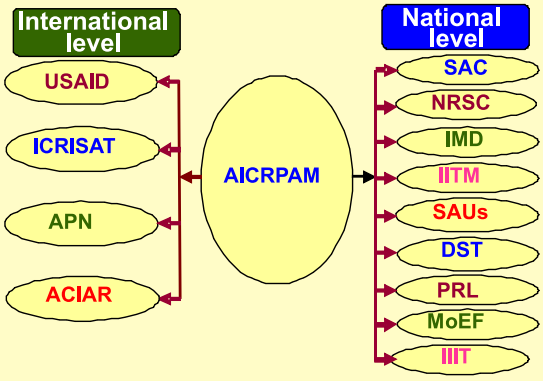
- Various Training Programs were conducted to the scientists of the project on Agroclimatic analysis, Agromet Advisory Services, Crop-Weather Modelling, Agrometeorological Aspects of Agricultural Production, Brassica Modelling, Database Management Techniques, Agricultural Drought: Aspects of Micrometeorology, Impact of Climate Change on Indian Agriculture and Agroclimatic Analysis, Crop Simulation Modelling and WebPage

Publications

Type of Publication	Cooperating Centres	Coordinating Unit
Books	27	7
Book Chapters	94	40
Bulletins / Manuals	98	12
Research Papers/ Popular Articles	1361	84

- Over the past 25 years, AICRPAM developed linkages with various State, National and International Institutions, Agencies for improving research, infrastructure development, technical support and Agro Advisory Services.

Future Plans



- Strengthening of agromet databases at individual centres for improving regional / micro level planning.
- Preparation of State-wise Agroclimatic Atlas and weather-based DSS for growing crops in different seasons.
- Studies on climate extremes and their probabilities, delineation of hotpsots and regions vulnerable to climate change and their impact on agricultural crops.
- Value addition to agromet information for improving the efficiency of agromet advisories and its dissemination in local languages using latest ICTs.
- Development of drought monitoring indicators by combining the climate and remote sensing information and preparation of drought vulnerability maps.
- Development of simple crop-weather relationships for use in AAS
- Studies on dynamics of pests and diseases in a cropping system mode as influenced by weather for development of thumb rules for forewarning models and Decision Support Systems, which are farmer-friendly and economically viable.
- Development of appropriate scientific criteria for crops and weather based insurance products
- Modelling impacts of climate change / variability on agricultural systems.
- New thrust areas on agrometeorological aspects in horticulture, livestock and agriculture in hill (northeast) and island regions.

For further details, contact:

Director, Central Research Institute for Dryland Agriculture or
Project Coordinator, All India Coordinated Project on Agrometeorology, CRIDA
P.O. Santoshnagar, HYDERABAD 500 059, Andhra Pradesh, India.
Telephone: +91 (40) 24530177 / 24530828; Fax: +91 (40)24534909 / 24531802
Email: director@crida.ernet.in/pc-agmet@crida.ernet.in
Web: www.crida.ernet.in; www.cropweatheroutlook.ernet.in

Compiled by: GGSN Rao, P. Vijaya Kumar, VUM Rao, AVM Subba Rao & IR Khandgond