Using long-term experimental data, relations were developed for forecasting the occurrence of various insect pest and animal diseases. For example, DSS for management of bacterial leaf spot in grapes, plentifully initiated incidence in its west for Bilaspur and, for aphid incidence in northern and western locations specific critical meteorological phenomena favoring several diseases in different crops were identified.

Crop specific, post-disease-weather relationships were developed for 46 separate insect pests and 12 diseases in six crops. A decision support model for fall frost in groundnuts, a decision model for aphid in mustard and ornamental model for yellow stem borers in rice and American Falls in cotton were developed.

The hot spot areas of tea mosquito bug across the cashew, the hot spot areas of rice E. coli across the cashew, the hot spot areas of leaf curl disease in cotton in relation to meteorological parameters at Hisar, Bijapur, etc. were identified.

A comprehensive bulletin on district level crop weather calendars of major crops in different states were prepared.

A bulletin on agrometeorological information of important crops in 12 agro-climatic regions were prepared by analyzing long-term empirical data of 41 Agromet centres. Those include - soybean (Maharashtra), rice (MP and Chhattisgarh), mustard (Haryana and New allied zone of Haryana), finger millet (Southern Karnataka, Karnataka), maize (Northwestern region of Rajasthan and southern region of Bihar), sorghum (eastern region of Rajasthan and southern Karnataka).

Downing 1972-2011, highest frequency (>30) hail events are noticed in 2987 (1972-2011).

Hailstorm can occur sporadically in India as a local phenomenon or, for example, DSS for forewarning the incidence of various diseases in different crops.

Studies on climate extremes and their probabilities, delineation of agro-climatic regions vulnerable to climate change and their impacts at state level of crops.

Development of simple crop level risk analysis methods for use in real time.

Studies on dynamics of pests and diseases in a cropping system need to be influenced by weather for development of more realistic forecast models and timely intervention systems, which are future.

Development of weather based insurance products for different crops.

Modelling impacts of climate change on variability of agricultural systems.

Agrometeorological studies in horticulture, livestock and agriculture in hill (northeast) and island regions.
Genesis

The fruits of tremendous progress made by ICAR and IASs in agricultural and allied sectors, are unable to materialize in their potential due to the often climatic extremes and frequent extreme weather. Tailoring the Indian agriculture to cope with these extreme weather abnormities augments significant improvements in the food and nutrition sector. This calls for a greater role of discipline of Agricultural Meteorology. Realizing its importance, the National Commission on Agriculture (NCA) in 1976 recommended establishment of Department of Agricultural Meteorology in all IASs. Consequently, ACRMFM (now CRIDA), Hyderabad in 1983.

Mandate

CRIDA conducts both basic and operational research covering all agro-ecologies. Each centre has one or more centres besides clinical characterization and studies in climate variability/change. In-Being Advisories Service (AAS) bulletins are issued based on research output from long-term experimentation and an awareness is in forming community through different communication and media. Farmer awareness programs in climate change and related issues are conducted regularly. The project consists of 111 staff that include 72 scientists, 42 technicians and 15 administrative.

Lifestyles

• Launch of sounding units at CRIDA, Hyderabad with 10 cooperating centers - 1993.
• Addition of two more centers - 1998.
• Installation of 150/USA Sub-projects - Instrumentation and capacity building of scientists - 1998.
• Addition of 12 new centres - 2006.
• Issue of weather-based agricultural advisories with NCMWF - 1997.
• Establishment of national level Agromet database - 1999.
• Addition of two more centers - 1989.

Project Accomplishments

Agroclimatic Characteristics

• Climate resources at micro level (block or tehsil) in respective states were assessed, analyzed and Agronomic limits (CL) were worked out for A.P., Chhattisgarh, Odisha, Rajasthan, Kerala and West Bengal states to optimize natural resource based crop calendars (CWC) for different crops were developed.

• State-wise crop growing cycle characteristics in irrigated and unirrigated crops and plantation crops were delineated based on rainfall, temperature and PET. The temperature and moisture index and moisture adequacy of derived indices like aridity were developed.

• Variety and traits in key climatic phenomena were assessed. Spatial distribution maps of monthly weather parameters, viz., maximum and minimum temperature and rainfall and those of derived indices like aridity index and moisture adequacy index and their seasonal trends were developed.

Crop-Water Relationships

• To achieve the above objectives, research is carried out in five thematic areas:
  • Agroclimatic characterization
  • Crop-Weather Relationships
  • Crop-Water Modelling
  • Weather indices in wheat, groundnut and cotton required for weather based crop insurance were identified.
  • Weather insurance products were developed.

Crop-Growth Modeling

• To study the agricultural climate in relation to crop planning and assessment of crop production presents in different agro-ecological regions.

• To establish crop-weather relationships for all the major rainfed and irrigated crops in different agro-ecological regions.

• To evaluate different techniques of modeling of crop moisture climate for improving the 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 data in the Agromet Databank at CRIDA.

• To develop, implement and disseminate crop production information and climate forecasting tools.

• To provide climate based agro advisories for medium range weather forecast and ICT.

• Process-based crop simulation models, joint issue of weather based agro-advisories with private sector weather services.

• To provide weather based agro advisories using medium range weather forecast and ICT.

• To provide agroclimatic characterization for all the major rainfed and irrigated crops.

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Launch of coordinating unit at CRIDA, Hyderabad with 10 Process-based crop simulation models.

Addition of 10 new centers (Provisional) - 2015.

Formats for collection of minimum data set (MDS) for 16 major crops was initiated.

To study the influence of weather on the incidence and spread of pests and diseases of field crops.

Agromet-Advisory Services

Climatic resources at micro level

Crop-Weather Modelling

Thematic maps of weekly rainfall and temperature

To achieve the above objectives, research is carried out in five thematic areas:

Crop Growth Modeling

Weather-based rainfall indices for different physiographic zones

Optimize natural resource based growth of crops

Critical temperature for tea leaves

Influence of length of dry spell during 51-80 ± 5 DAS on groundnut yields at Anantapur

Stress degree days based relation for optimising pearl millet grain yield

Relationship of canopy temperature and yield in mustard at Faizabad

Effect of minimum temperature during reproductive period on wheat yield

Trends in a) annual and b) kharif season minimum temperature (1971-2009)

In eastern India, using block-level daily interval, crop statistics and soil information, climatic forecasts for low productivity of rice were identified.

Weather indices in wheat, groundnut and cotton required for weather based crop insurance were developed.

Crop-Weather Relationships

Crop-Growth Modeling

Kanpur

Raipur

maximum and minimum

Chhattisgarh, Odisha, Rajasthan, Kerala and West Bengal states to Kerala and W.Bengal states toagroclimatic regions were identified for major field and orchard crops spread over various agroclimatic zones. These forms in basic designing the location specific agrometeorological guidelines.

To study the agricultural climate in relation to crop planning and assessment of crop production presents in different agricultural regions.

To enhance different crop-weather relationships for all the major rainfed and irrigated crops in different agricultural regions.

To evaluate different techniques of moulding of crop micro climate for improving the 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.

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Thematic maps of weekly rainfall and temperature

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To study the influence of weather on the incidence and spread of pests and diseases of field crops.
Genesis
The fruits of tremendous progress made by ICAR and ICAR-SAI in agricultural and allied sectors, are
inadequate to sustain their growth potential due to the ever-increasing demand for food and	exponentially
increasing climatic extremes. Tailoring the Indian agriculture to cope with these climatic aberrations
means augmentation of the food base and nutritional security. This calls for a greater role of discipline of
Agricultural Meteorology. Realising its importance, the National Commission on Agriculture (NCA) in
1976 recommended establishment of Departments of Agricultural Meteorology in all ICARs. Consequently,
ACRIARM was commissioned at CRIDA, Hyderabad in 1983.

Mandate
ACRRAH conducts both basic and operational research covering all agro-ecologies. Each centre has
one or two mandaleebes besides climatic characterization and studies on climate variability/change.
Bi-weekly Agromet Advisory Service (AAS) bulletin is issued based on research output from long-
term experimentation and is a dissemination instrument to farming community through different
communication media.Farmer awareness programs on climate change and related issues are conducted regularly.
The project consists of 111 staff that includes 37 scientific, 62 technical and 12 administrative.

Objectives
To study the agricultural climate in relation to crop planning and assessment of crop production
presented in different agro-climatic regions.
To establish crop-weather relationships for all the major rained and irrigated crops in different
agricultural regions.
To evaluate different techniques of modellization of crop yields for improving the yield using	climate
and climatic variation predictability of the crops.
To study the influence of weather on the incidence and spread of pests and diseases of fallow crops.
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To study the agricultural climate in relation to crop planning and assessment of crop production presents in different agro-climatic regions.

To establish crop-weather relationships for the major rainfed and irrigated crops in different agro-climatic regions.

To evaluate different techniques of modelling of crop micro-clIMATE for improving the 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

Crop-Weather Relationships

To provide weather-based agro-advisories using medium range weather forecast and ICT

To collect and store data on weather variability and climatic resources at micro level

Databases for collection of minimum data set (MDS) for 16 major crops was initiated. The MDS format facilitates data usage in crop-weather relations, crop simulation modeling and development of agromet advisory services.

To study the agricultural climate in relation to crop planning and assessment of crop production presents in different agro-climatic regions.

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Using long-term experimental data, relationships were developed for forecasting the frequency of various insect pest and disease. For example, EOS for management of bacterial leaf spot in pigeonpea, pigeonpea blight incidence in pigeonpea (B. vulgaris) and aphid incidence in sorghum (Sorghum bicolor). Locationspecific critical pest pressure favoring several disease in different crops were identified.

Crop specific post-disease-weather relationships were developed for 92 major insect pests and 12 diseases in six crops. A decision support model for foot rot in groundnut, a disease model for aphids in maize and red beet leaf curl in beet were included. The impact of two monsoon fog seasons on chickpea cultivation of the region were demonstrated considering optimum ripening stage during flowering and fogging stage by Thiruvananthapuram.

- Hill of 80 per cent, right temperature less than 20 °C and coldly conditions favor the development of black stem disease in rice in Palakkad.
- Maximum temperature in the range of 30 to 31 °C, minimum temperature 25 to 26 °C, evening relative humidity of 90 to 92% and evening relative humidity of 62 to 65% was found ideal for pink spot nosfera population in soyabean.

- Field of severe black stem disease was recorded in rice in Palakkad.
- All centers issue Agromet Advisory Services twice a week, regularly.
- A comprehensive bulletin on district level crop weather calendars of major crops in different states were prepared by analyzing long-term experimental data of individual centers.
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Extensive awareness campaign was made by analyzing long-term hailstorm data at different sites of the country.
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- PET calculator 3.0 – to estimate the potential or apparent evaporation demands of crops, based on the data availability of a given location.
- Relative v.1.0 – to estimate the reliability of observed yield/estimated yield by comparing with original observed yield using statistical tools.

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Crop specific, post-disease-weather relationships were developed for 39 insect pest types and 13 diseases in six crops. A decision support model for the spot in groundnut, a drastic model for aphid in mustard and red bean model for yellow rust, bean rust and American full in cotton were developed.

The hotspot areas of tea mosquito bug across the cashew and are identified. A comprehensive study on the soil-leaf- stripe epidemic of major crops in India was made by analyzing long-term historical data in different states of the country. A comprehensive bulletin on district level crop weather calendars of major crops in 32 centers. Activities on agrometeorological important crops in different states were planned by analyzing long-term experimental data at 41 AICRPAM centers. These include soybean, mustard, pigeon pea, guar, Pigeon pea, onion, and soybean for the northern region of Karnataka.

Usingcroppest vidyavishva website is in operation at AICRPAM Coordinating Unit (CRIDA) for better dissemination of weather-based disease risk in rice at Palampur. Maximum temperature in the range of 30 to 32°C, minimum temperature of 23 to 24°C, morning relative humidity of 90 to 92% and evening relative humidity of 62 to 65% were found congenial for peak semi looper development in cultivated regions of the country. Blast disease in rice at Palampur. 20°C and cloudy conditions favoured the development and flowering stage by Thrissur center.

AICRPAM centers. These include - Weathercock v1.0 - to analyze climatic data for characterizing crop weather calendars of major crops in India. PET calculator v3.5.0 - to estimate the potential or equivalent evapotranspiration demand on the date availability of a given location. Balance v3.0 - to estimate the reliability of estimated electrical yield by comparing with original observed data using statistical tools.

All centers issue Agromet Advisory Services twice a week, regularly. About 53 training programs were conducted for scientists in the project as well as the scientists from other agricultural institutions and universities. About 370 farmers’ awareness programs were conducted to educate on the ill-effects of climate change and management practices to mitigate their adverse effects. All together, 55,921 farmers (Male-44,246, Female-11,666) were benefitted. Change and management practices to mitigate their adverse effects. All put together, 55,912 farmers (Male-44,246, Female-11,666) were benefitted.

All India Coordinated Research Project on Agrometeorology (AICRPAM) was awarded Chaudhary Devilal outstanding All India Coordinated Research Project award-2010 by ICAR.

Weather Effects on Pests and Diseases

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Using long-term experimental data, relations were developed for forecasting the occurrence of various insect pest and disease. For example, DSS for management of bacterial leaf spot in grapes, powdery mildew incidence in wine grapes, and aflatoxin incidence in southeastern Australia. Location-specific critical pest episodes favoring several insect pests and diseases were identified.

Crop-specific, post-damage-weather relationships were developed for 39 graminaceous pests and 12 diseases in six crops. A decision support model for leaf spot in grapevine, a diagnostic model for apple in northern and rural mountain belt for yellow stem borer in rice, and American bollworm in cotton were developed.

The hotspots of the major bagworms across the cultural conditions of the districts were demarcated considering optimum emergence thresholds during blooming stage for rice and flowering stage for cotton. The model was cross-validated for 180 locations.

A website www.aicrpam-nicra-aws.in is in operation at AICRPAM Coordinating Unit (CRIDA) for better dissemination of weather-based services to rice in Patiala.

Maximum temperature in the range of 30 to 36°C, minimum temperature 23 to 24°C, morning relative humidity of 90% to 92% and evening relative humidity of 62% to 80% was found ideal for pink bollworm population in soyaab.

Agromet Advisories

• Issued of micro-level (block level) agromet advisories has been initiated at six centres viz. Bijapur, Bidar, Bijapaur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijapur, Bijap