Project No. 3

Crop weather relation studies in *Rabi* Sorghum

Objectives:

- To study the effect of weekly weather variables on crop yield
- Develop Crop yield prediction models using historical weather data and yield

Results:

1996-97

A multi-date sowing experiment was commenced in order to induce varying environmental situations during crop growing period. The important observations made during the course of the experiment were:

- In the first growing environment, the crop experienced excessive rainfall during primordial initiation stage, and thereby resulting in high soil moisture situation causing profuse vegetative growth of the crop. Higher temperatures during the flowering stage were noticed.
- In the last growing environment , the crop experienced sudden increase in minimum temperature during reproductive stage.
- These factors may have affected the crop yield.

1997-98

The data collected from experimental records of the AICRP for Dryland Agriculture and the AICRP on Agrometeorology for the years 1989-90, 1990-91, 1994-95, 1995-96, 1996-97 with respect to date of sowing, flowering-time and crop yield, and corresponding weather data of Regional Research Station, Bijapur were analyzed for correlation coefficients between agrometeorological variables in different weeks after sowing and the *Rabi* sorghum seed yield.

Rainfall during 4^{th}, 5^{th}, 6^{th}, 8^{th} and 9^{th} weeks after sowing was associated favorably with final yield. These weeks correspond to primordial initiation and vegetative stages of crop growth. The yield was negatively associated with maximum temperature throughout the growing season with particular emphasis in the reproductive period of 9^{th} to 11^{th} weeks after sowing. Higher minimum temperature, higher morning time relative humidity and lower afternoon relative humidity were factors that favored higher yield in *Rabi* sorghum.

The moisture availability index in the eighth week after sowing was best associated with sorghum grain yield, with a correlation coefficient of 0.53. Regression model was developed using the moisture availability index in the eighth week after sowing.

$$Y = 1130.4 + 14.16\ MAI\ (8)$$

Where, Y is the grain yield in kg/ha and

MAI (8) is the moisture availability index in eighth week after sowing

1998-99, 1999-2000

The experiment on *Rabi* sorghum was continued for collection of more data for arriving at meaningful results. The observations indicated that, maximum temperature during the crop growing period of earlier sown crop was lower during the seedling stage,

while it was higher during 8-12 weeks after sowing, i.e., reproductive period, which may have contributed to lower yields.

2000-01

Observations similar to the 1999 were noticed during this years reporting also, that is earlier sown crop yielded less in view of higher temperatures during the reproductive period of the sorghum crop. Normally, as per the recommendations of the Station, earlier sown crop yielded more. However, the results noticed during the past couple of years are in contrast to the rest, which is ascribed to the higher temperatures in reproductive phase of the crop. Collection of data on dry matter partitioning is also commenced during this year, so as to support crop growth modeling studies in future.

2001-02

The experimental data collection is continued. During this year, the initial rainfall was only about 45 mm in the first week after sowing (WAS) and the depleting soil moisture situation commenced from the 6^{th} WAS in case of the first growing environment. Good vegetative growth was noticed in view of the favorable moisture condition during panicle initiation and early flowering period. On the other hand the crop of second growing environment received rainfall onlytill the 4^{th} WAS, resulting in poor vegetative growth as well as undergoing terminal moisture stress. Coupled with these basic moisture conditions, the other agrometeorological variables, namely, maximum temperature, minimum temperature, sunshine and relative humidity resulted in altering the stage-wise Agrometeorology of the crop for determining the yield differences. Higher sunshine duration during the earhead emergence of the crop of second growing environment was no favorable in view of early stress and causing lower vegetative production due to change in morpho-physiological as well as photosynthetic activities. The maximum temperature was higher in crop of GE1 during the vegetative and flowering stages, which may have provided higher energy for higher and beneficial biomass production. On the other hand, the crop of GE2 experienced higher temperature in the early seed setting period, which resulted in thermal stress in addition to already prevailing moisture stress. Additionally, the minimum temperature was below the base temperature of 10 C seed setting period for the crop in GE1, resulting in general, physiological stress.

2002-03

In a year of typical receding soil moisture situation of Bijapur, there was complete cessation of rainfall in the 42^{nd} standard week, which corresponded to the 5^{th} WAS for GE1 crop and 3^{rd} WAS for GE2 crop. This resulted in early commencement of water deficiency for the crop in GE2, and hence caused relative reduction in growth and yield. Dry matter differences were noticed only from flowering time onwards in the growing environments. Highest differences in leaf biomass occurred during the seed setting stage, whereas differences in stem biomass occurred in vegetative period itself. Causal factors for reduced biomass could be attributed to low moisture content for GE2 crop at all depths of soil from 15cm to 90cm. Also, the crop in GE2 encountered higher temperature range during the flowering stage. Further, lower temperature range during the seed setting stage affected the seed setting in GE2 crop. On the other hand, the crop in GE1 encountered higher temperature range during this stage, which facilitated better translocation of the photosynthates

Correlation analysis between grain yield in *Rabi* sorghum genotype M35-1 and the weekly meteorological variables during crop growing period was performed. Rainfall during the 4-5 WAS is important for all genotypes. The maximum temperature has good association in WAS10. Lowering of minimum temperature during 12-14 WAS in general and WAS14 in particular has a role in increasing the sorghum grain yield. The yield is positively associated with morning vapour pressure during 5, 6 and 8 WAS. The grain yield is positively associated with cloud cover during WAS 4 -5. The association of yield with evaporation rate is negative in WAS7.

Yield models for sorghum:

The models for grain yield of *Rabi* sorghum developed, considering the correlation analysis, are presented in Table 3.1. It is seen that the coefficient of determination is very high.

Model No.	Model	R^2
1	Y= 1.62(RF5)+1.99(RH28)+282.4(TX10)-151.6(TN12)-60009.2	0.93
2	Y= - 18.9(RH28)+560.9(TX10)-324.2(TN12)+119.7(TN14)-13033.4	0.94

Table 3.1 Yield Models for Sorghum genotype M35-1

RF5 = Rainfall during the 5th week after sowing (WAS)
RH28 = Afternoon relative humidity during WAS 8
TX10 = Maximum Temperature during WAS 10
TN12 = Minimum Temperature during WAS 12
TN14 = Minimum Temperature during WAS 14

Where,

It is noticed that the model parameters are afternoon vapor pressure in WAS2, afternoon relative humidity in WAS8, rainfall during WAS5, and minimum temperature in WAS 12 & 14.

2003-04

The *Rabi* sorghum crop failed to establish during the crop season 2003-04 in view of meager rainfall, and hence the experiment was vitiated.