

ASSESSMENT OF MODIFIED WEATHER ON RICE YIELDS USING CERES RICE MODEL IN ANDHRA PRADESH

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KEYWORDS: DSSAT V4.0, Elevated Temperature, Solar Radiation, Grain Yield, Biomass, Nitrogen levels.

ABSTRACT:

Field experiment was conducted under 3 different planting dates and 5 nitrogen levels to assess the impact of modified weather on yield and biomass of rice using CERES-Rice at Agricultural Research Institute, Acharya N. G. Ranga Agricultural University, Hyderabad. The percent error was 7 and -11.4% in grain yield when crop was planted on 25th July and 29th August, respectively. Increase biomass was observed with increasing levels of nitrogen from 100 to 300 kg /ha. Grain yield has decreased with elevated temperatures during entire crop growth and reduced solar radiation during flowering to beginning of grain filling in all the dates of planting and nitrogen levels.

1. INTRODUCTION

Weather plays an important role in agricultural production. Amongst the various weather elements, temperatures and radiation play major role in deciding the crop growth, development and yield levels. As per the recent report of Inter-governmental panel on climate change (IPCC, 2007), the crop yield in many countries of Asia has declined, partly due to rising temperatures and extreme weather events. In India studies by several authors shown that during last century there is observed increased trend in surface temperature (Singh et. al 2001). Sinha (1994) reported that higher temperatures and reduced radiation associated with increased cloudiness caused spikelet sterility and reduced yields to such extent that any increasing dry matter production as result of CO₂ fertilization proved to be no advantage in grain productivity. Amien etal (1996) reported that rice yield in East Java could decline by 1% annually as a result of increasing temperature. In Asia, where rice is one of the main staple foods, production and distribution of rice growing areas may be affected substantially by climate change. Although C₃ crops exhibit a positive response to increased CO₂, the optimal productive temperature range is quite narrow. The state of Andhra Pradesh is frequently prone to cyclones during September to November which is characterized by cloudy weather for 3-5 days causing reduction in availability of solar radiation during flowering and grain yielding stage and affecting the yield of rice crop. In Andhra Pradesh the temperatures are projected to increase by at least 3^oC through out the state by 2041 to 2060 this increase occurs in all seasons of the year by considering the productions on climate change study was under taken to assess the impact of climate change under different nitrogen levels on yield and biomass using CERES-Rice model.

2. MATERIALS AND METHODS

The field experiment was conducted during Kharif 2007 at Agricultural Research Institute, A.N.G.R.Agricultural University, Rajendranagar, Hyderabad to study influence of different levels of nitrogen on yield and biomass of rice using CERES-Rice. The treatments comprised of 3 dates of planting (D₁=25.07.2007,

D₂=08.08.2007, D₃=29.8.2007) and five nitrogen levels (N₁=100kg /ha, N₂=150kg/ha, N₃=200kg/ha, N₄=250kg/ha, N₅=300kg/ha). The experiment was laid out in clay loam soil. The nitrogen was applied in three equal splits i.e. at basal, 20 days after planting and panicle initiation stage. Other packages of practices are followed as per the recommendations of A.N.G.R.Agricultural University. The variety chosen was short duration cultivar MTU 1010. DSSAT V4.0 was used to study the impact of temperature and solar radiation on yield and biomass of rice using 40 years long term weather data of Rajendranagar. The temperatures were elevated to 1^oC and 2^oC during the entire crop season and solar radiation was reduced to 1% during flowering to beginning of grain filling (increased cloudiness by 99%).

3. RESULTS AND DISCUSSION

The simulated and observed grain yield and biomass of rice under different dates of planting using CERES-Rice are presented in Table 1. The results revealed that the % error was 7 and 4.7% grain yield compared to observed under normal (up to August 8th) and 11.4% lower yield than normal under delayed (29th August) planting. Among the nitrogen levels the model has predicted the grain yield with percent error of -16.6 to 11.7% from 100 kg to 250 kg nitrogen per hectare (Table 2).

The grain yield simulated under different planting dates and different climate change scenarios using CERES-Rice was depicted in fig.1. Results revealed that there was a drastic decrease in grain yield of rice under delayed planting and elevated temperature by 1^oC and 2^oC and reduced solar radiation during flowering to beginning of grain filling stage (1 week). The grain yield did not differ much under elevated temperatures and reduced solar radiation conditions when crop was planted on 25 July and Aug 8. Among the nitrogen levels the model has simulated increased grain yield with increasing levels of nitrogen from 100 to 300 kg per hectare even under elevated temperatures and reduced solar radiation during flowering to beginning of grain filling (Fig 2).

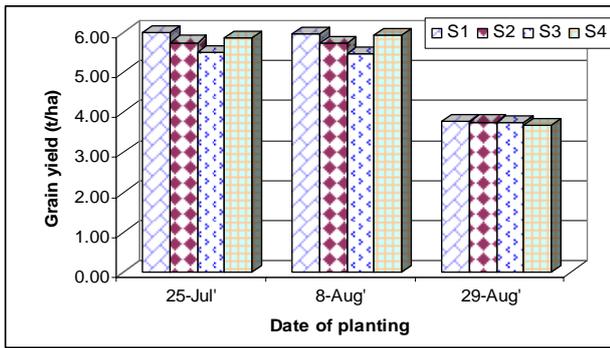


Figure 1. Grain Yield of Rice as Influenced by Dates of Planting under Different Climate Change Scenarios

S1= Normal, S2= Temperature increase by 1^oC,
S3= Temperature increase by 2^oC, S4= Reduced radiation to 1%

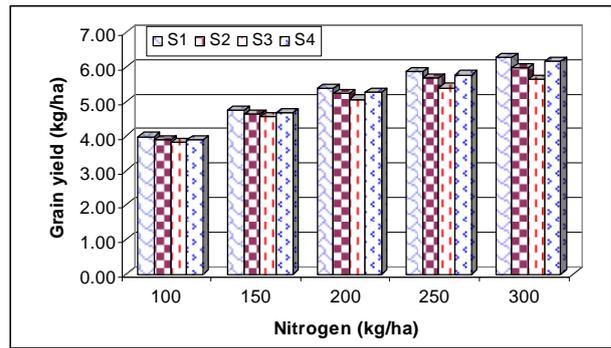


Figure 2. Grain Yield of Rice as Influenced by Nitrogen Levels under Different Climate Change Scenarios

S1= Normal, S2= Temperature increase by 1^oC,
S3= Temperature increase by 2^oC, S4= Reduced radiation to 1%

Date of planting	Grain yield (t/ha)		%Dev	Biomass (t/ha)		%Dev
	Observed	Simulated		Observed	Simulated	
25-Jul	6.42	6.87	7.0	14.77	14.34	-2.9
8-Aug	6.89	7.21	4.7	13.31	14.22	6.9
29-Aug	6.96	6.17	-11.4	15.46	14.23	-8.0

Table 1: Observed and Simulated Grain Yield and Biomass of rice MTU 1010 Under Different Dates of Planting Using CERES-Rice During Kharif 2007.

N (kg/ha)	Grain yield (t/ha)		%Dev	Biomass (t/ha)		%Dev
	Observed	Simulated		Observed	Simulated	
100	6.50	5.42	-16.6	13.40	12.01	-10.4
150	6.32	5.99	-5.2	13.73	13.17	-4.1
200	7.07	7.09	0.3	15.11	14.56	-3.6
250	6.74	7.53	11.7	14.78	15.59	5.4
300	7.14	7.71	8.1	15.56	15.99	2.8

Table 2: Observed and Simulated Grain Yield and Biomass of Rice MTU 1010 Under Different Levels of Nitrogen Using CERES-Rice During Kharif 2007.

Similarly the biomass of rice simulated using CERES-Rice model under different planting and elevated temperatures and reduced solar radiation are depicted in fig 3. Results showed that the simulated biomass under different elevated temperatures and reduced solar radiation were higher when crop was planted on 25th

July and 8th August and there was a drastic reduction in simulated biomass when crop was planted on 29th August. Among the nitrogen levels the model has predicted highest biomass yield with increased levels of nitrogen from 100kg to 300 kg per hectare (Fig 4).

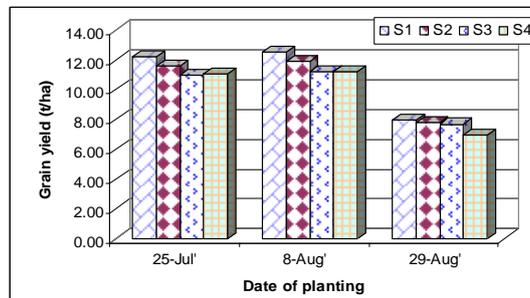


Figure 3. Bio Mass of Rice as Influenced by Dates of Planting under Different Climate Change Scenarios.

S1= Normal, S2= Temperature increase by 1^oC,
S3= Temperature increase by 2^oC, S4= Reduced radiation to 1%

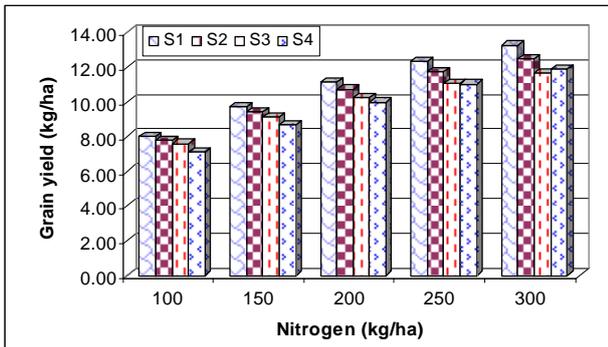


Figure 4. Bio Mass of Rice as Influenced by Nitrogen Levels under Different Climate Change Scenarios.

S1= Normal, S2= Temperature increase by 1⁰C,

S3= Temperature increase by 2⁰C, S4= Reduced radiation to 1%

CONCLUSION

Model has predicted the grain and biomass yields correctly and are within permissible limits. From the study, the planting of short duration variety should not be delayed beyond August 8th with optimum nitrogen level of 250 kg/ha.

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