1. Project Title:

Impact of Tropospheric Ozone on Crop Production under Jute-Rice Cropping System

2. Brief introductory note

Ozone (O_3) is a gaseous pollutant in the lower level of the atmosphere, the troposphere, causing a serious threat to global crop production in major agricultural regions of the world in changing climate scenario. The total ozone (O_3) concentration increases during pre-monsoon and winter periods due to rise of temperature in changing climatic scenario. During the season, jute (pre-monsoon) and boro rice (winter) are the major crops grown in rural areas of West Bengal and such crops has been classified as moderately sensitive to O_3. This study was undertaken to investigate O_3-induced risk using ethylenediurea (EDU) treatment in two important crop plants i.e. boro rice and jute in field conditions. In addition to assessment of jute and rice production losses from risk of ozone induced damage, the screening of best cultivars of such crops for their O_3 sensitivity/tolerance is also being done which may reduce the detrimental environmental effects associated with increased levels of ozone.

3. Broad objectives

- To screen cultivars of jute and rice for their O_3 sensitivity/tolerance.
- To identify the most responsive parameters for screening O_3 tolerant jute and rice cultivars using EDU as a tool.
- To find variation in the response of different cultivars of crops to EDU treatment under high ambient O_3 concentrations.
- To collate the existing knowledge and data in order to understand the magnitude of potential O_3 problems with respect to plant productivity.

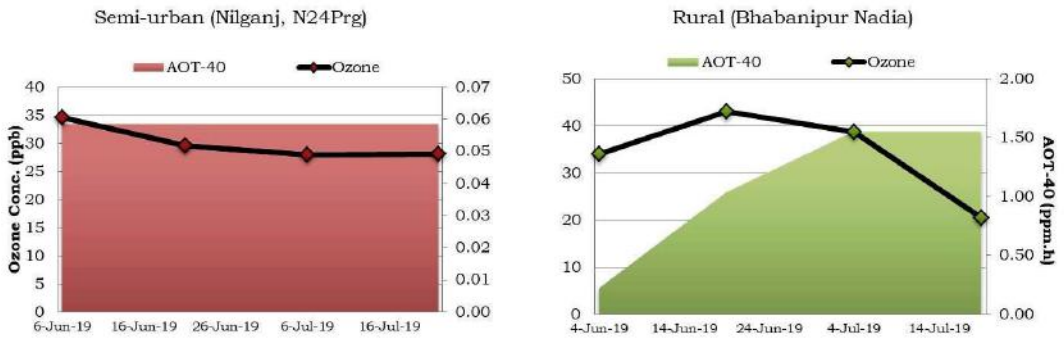
4. Significant achievements (2019-20)

- Three rice cultivars (IR36, MTU1010 & BG3) and four jute cultivars (JRO524, JRO204, S19 & NJ7010) were screened for ozone (O_3) tolerance and for the most responsive parameters with EDU treatments at two experimental sites of West Bengal experiencing high ambient O_3 conditions.
- EDU was applied from beginning of vegetative stage until the final harvest phase as a foliar spray at 300 ppm in order to protect the plants from the adverse effects of O_3.
- Antioxidant activity, malondialdehyde content (MDA) and chlorophyll content at the vegetative and flowering phases and harvest-related parameters are being studied.
- Daytime ozone levels often exceeded 40 ppb and increased further throughout the experiment, attaining maximum levels at the peak vegetative and reproductive phase during boro rice season.
- IR-36 and BG-3 cultivars of rice under study were found sensitive to ambient ozone concentrations, as evidenced by increased yield and antioxidative defense under EDU treatments.
- During jute crop field experiment, O_3 concentrations were low during the peak vegetative and maturity phase in June-July due to the onset of the pre-monsoon period, leading to wash-out of O_3 precursors. However, the hourly O_3 concentrations increase above 'the critical level', i.e., 40 ppb, in main vegetative stage (May-June).
- There was no significant yield difference in JRO204 variety where AOT40 was higher during vegetative phase and this cultivar may be considered as well adapted to ozone exposure.

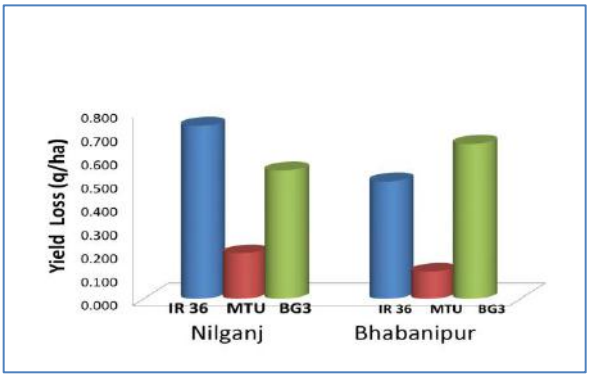
- Increase in CAT activity at the vegetative and reproductive phases of rice plant was the only parameter that was responsive at both field sites.
- EDU-mediated protection against O_3 stress in rice is mainly carried out by the antioxidant defence system (SOD, CAT & MDA) as an indicator.
- The present experiment indicates that prevailing ozone concentrations in Indo-Gangetic Plains of West Bengal may have negative impact on growth and yield of rice and jute.

Boro Rice experiment at Village
(Bhabanipur, Nadia dist., W.B.)

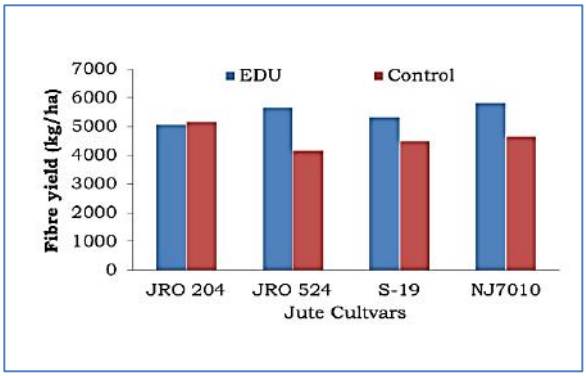
Jute crop experiment at CRIJAF Farm
(Nilganj, North 24 Parganas dist., W.B.)



Ozone concentration during jute growing season (year 2019)



Impact of O_3 on rice grain yield loss
(CRIJAF, 2019)



Impact of O_3 on jute fibre yield
(CRIJAF, 2019)

5. SCSP Component

Farmer's Training-cum-Scientist Interaction: Climate Resilient Jute based Cropping System

Farmer's training-cum-Scientist interaction was organized under SCSP component of NICRA project to disseminate the problem solving knowledge and farm input products as developed and standardized in farmer's field by the ICAR-CRIJAF scientists. Altogether 57 Scheduled Caste farmers of West Bengal were trained (2019-20). Farm inputs like seeds and pesticides were distributed to all farmers (20 hectare area in 2 villages) for line sowing of jute seeds and intercropping with green gram to overcome climate change problem due to weeds, moisture stress, pests and diseases.

Farmers-Scientists interaction and farm input distribution

Farmers receiving certificate from Director, ICAR-CRIJAF

Line sowing (jute) and weeding using CRIJAF-Seed drill and Nail Weeder & Herbicide application

Jute-green gram intercropping under NICRA (SCSP) in Galdaha village, N24Prg, W.B.

6. NICRA Team:

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