INTERNATIONAL JOURNAL OF RESEARCHES IN BIOSCIENCES, AGRICULTURE AND TECHNOLOGY

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CO-RELATION BETWEEN VEGETATIVE GROWTH AND ELEVATED CO_2 IN COTTON & TUR

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ABSTRACT:
Diseases are responsible for losses of at least 10% of global food production representing a threat to food security. It is estimated that annual losses by disease cost US$ 220 billion. Besides direct losses, the methods for disease control especially the chemical methods can result in environmental contamination and in residual chemicals in food, in addition to social and economic problems. Ten rows were prepared were also grown in elevated conditions like increased CO_2 or increase in temperature or both in Open Top CO_2 Chambers (OTC). Root length (cm), Shoot Length (cm) and Number of leaves (Nos.) were observed at 450 ppm 500ppm and 550 ppm respectively. Four units of OTCs were already established and plants have been exposed to controlled temp, humidity and various CO2 for study of physiological changes in different growth AMB: AMBIENT OUTSIDE OTC1: AMBIENT $C0_2$ (CONTROL) , OTC2: ELEVATED $C0_2$ (400ppm)+ Ambient Temp, OTC3: ELEVATED $C0_2$ (450ppm)+ Ambient Temp, and OTC4: ELEVATED $C0_2$ 500ppm + Ambient Temp. it was observed that no At 450 ppm, 500 ppm and 550 ppm of CO2 concentration there was no significant difference in the root length (cm) in the Cotton but there was significant and noticeable change in the root length (cm) of Tur crop, there was no significant difference in the shoot length (cm) in the Tur but there was significant and noticeable change in the shoot length (cm) of Cotton and there was no significant difference in the number of leaves there was significant and noticeable change in the number of leaves of Cotton and Tur in OTC.

***Keywords**: Cotton, Tur, OTC, elevated CO2 and ppm.*

INTRODUCTION:

India's geography and geology are climatically pivotal the Thar Desert in the northwest and the Himalayas in the north, work in tandem to effect a culturally and economically break-all monsoonal regimes. As Earth's highest and most massive mountain range, the Putain Pende system bars the influx of frigid katabatic winds from the icy Tibetan Plateau and northerly Central Asia. Most of North India is thus kept warm or is only mildly chilly or cold during winter; the same thermal dam keeps most regions in India hot in summer.

Nagpur is the second capital and the third most populous city of the Indian state of Maharashtra. It is the 13th most populous city and 13th largest urban agglomeration in India. Nagpur is the seat of the annual winter session of the Maharashtra state assembly, "Vidhan Sabha". Nagpur has tropical wet and dry climate (Köppen climate classification) with dry conditions prevailing for most of the year. It receives an annual rainfall of 1,205 mm (47.44 inches) from monsoon rains during June to September. The highest recorded daily rainfall was 304 mm on 14 July 1994. Summers are extremely hot, lasting from March to June, with May being the hottest month. Winter lasts from November to January, during which temperatures drop below 10 °C. The highest recorded temperature in the city was 48 °C on May 19, 2015, while the lowest was 3.9 °C January 7, 1937. The classic disease triangle establishes the conditions for disease development i.e. the interaction of a susceptible host, a virulent pathogen and a favourable environment. This relationship is evidenced in the definition of plant disease itself. A plant disease is a dynamic process in which a host and a pathogen intimately related to the environment are mutually influenced, resulting in morphological and physiological changes.

Diseases are responsible for losses of at least 10% of global food production representing a threat to food security. It is estimated that annual losses by disease cost US$ 220 billion. Besides direct losses, the methods for disease control especially the chemical methods can result in environmental contamination and in residual chemicals in food, in addition to social and economic problems. The close relationship between the environment and diseases suggests that climate change will cause modifications in the current phytosanitary scenario. Thomas and Strain (1991) reported that the main effect of CO_2 enrichment was to triple the number of branches and to increase total branch length six times. Enhanced and accelerated branching also increased total leaf area 50% at elevated CO_2 concentrations. In coral honey suckle, total biomass was only 40% greater in the elevated CO_2 treatments. Branching was quadrupled but had not proceeded long enough to affect total leaf area. Main stem height was increased 36% at 1,000 µl/liter CO_2 .

Free-air CO_2 enrichment (FACE) experiments allow study of the effects of elevated CO_2 on plants and ecosystems grown under natural conditions without enclosure (Ainsworth, 2005). The results confirm from previous chamber experiments: light-saturated carbon uptake, diurnal C assimilation, growth and above-ground production increased while specific leaf area and stomatal conductance decreased in elevated CO_2 . There were differences in FACE. Trees were more responsive than herbaceous species to elevated CO_2 . Grain crop yields increased far less than anticipated from prior enclosure studies. there was no significant difference in the root length (cm) in the Cotton but was significant and noticeable change in the root length (cm) of Tur crop was no significant difference in the shoot length (cm) in the Tur but noticeable change in the shoot length (cm) of Cotton crop that there was significant difference in the number of leaves in Cotton and Tur crops in the OTC chamber.

METHOD AND MATERIAL:

Data Collection

Meteorological data

Meteorological data such as Ambient Temperature in 0C (of last four decades), Rainfall (no. of rainy days), Relative Humidity (%), changes in the percentage of CO2 , Diseases to major crops in the study area, Crop Disease Management techniques, farming techniques, vector population control process, use of pesticides, fertilizer use/application, seed quality, causative agents of the diseases to crops, damages caused by diseases to crop yield, etc.

Experimental Data

- Root length (cm)
- Shoot Length (cm)
- Number of leaves (Nos.)
- Number of Fruits (Nos.) Cotton, Tur, Moong, Groundnut, Soyabean
- Weight of Fruits (gm) Cotton, Groundnut, Soyabean.
- Weight of Seeds or 100 seed weight of Tur, Moong (gm).

Field Experiment

Ten rows were prepared were also grown in elevated conditions like increased CO_2 or increase in temperature or both in Open Top CO2 Chambers (OTC).

OPEN TOP CHAMBER (OTC)

A brief description of technology: The purpose of OTC is to study response of plants in high CO_2 and other gas in environment with precise control and regulation of desired CO_2 , temperature and humidity inside the OTC. Open Top Chambers is an innovative and cost effective approach to investigate effects of elevated CO_2 , temperature and humidity on the growth dynamics and yield response of plants. In this approach CO_2 gas is supplied to the chambers through CO_2 gas cylinders and maintained at the set levels using manifold gas regulators, pressure pipelines, solenoid valves, sampler, pump, CO_2 analyzer ,PC linked supervisory control and data acquisition (SCADA). The data generated by Open Top Chambers are more realistic for impact assessment analysis of rising atmospheric CO_2 and temperature on plants for developing models to predict the responses for future climatic conditions. The accuracy of the result depends on the system adopted and its maintenance of the required CO_2 levels with near natural and variable conditions for other parameters. Four units of Open Top Chambers for elevated CO_2 study, were provided by department with high quality multilayered polycarbonate sheets (4mm thickness) of 3X3X4mt. dimensions with GI/MS structure with proper foundation and grouting. A suitable door of 6X3 ft size is provided in each chamber. Multilayered clear polycarbonate sheet with 80-85% light transmission level is used for Open Top Chamber structure. Flat and angle aluminum and rust free screws are used for mounting of polycarbonate sheet. Welding at four corners and inclination of 30 degree at the top is provided to protect against high winds and moderate vibrations. Sealing of Open Top Chamber is achieved using aluminum angles plates at the top, corners and centre along with gaskets. Door is sealed using U type gaskets with overlapping of sheets to prevent loss of CO_2 . Four units of OTCs were already established and plants have been exposed to controlled temp, humidity and various CO_2 for study of physiological changes in different growth

AMB: AMBIENT OUTSIDE

OTC1: AMBIENT CO_2 (CONTROL)

OTC2: ELEVATED CO_2 (400ppm)+ Ambient Temp

OTC3: ELEVATED CO_2 (450ppm)+ Ambient Temp

OTC4: ELEVATED CO_2 500ppm + Ambient Temp

Field Supervision

With respect to the objectives of the study, care was taken to visit the localities at such a time that the respondents would be available for interaction. Furthermore, a check sheet was prepared to mark the data collection for a specific time period i.e. day, week, month, etc. to ensure that all the necessary data points have been recorded.

RESULTS AND DISCUSSION

Table 1. The average root length (cm) of the crops in the study area is presentated in Table 6.13. The average root length of cotton plant under the ambient OTC is 7.5 ±0.3and the average root length of cotton plant under the ambient field is 7.3. ±0.4. The root length (cm) in the cotton crop of the study area with 450 ppm 8.5±0.4, 500 ppm 8.8±0.2 and 550 ppm 8.9±0.2 No significant difference was found. The average root length of Tur plant under the ambient OTC is 7.6 ±0.4and ambient field is 7.5 ± 0.3 respectively. The root length (cm)in the Tur crop of the study area with 450ppm 8.6±0.7, 500 ppm 9.4±0.6 and 550 ppm 10.5±0.9 Significant difference was found ($P<0.05$).

Although there was no significant difference in the root length (cm) in the Cotton but noticeable change in the root length (cm) of Tur crop in the study area.

Above Table 2—presents results of the average shoot length (cm) of the crops in the study area. The average shoot length of cotton plant under the ambient OTC is 58.4 ±10.1and ambient field is 56.1±9.8 respectively. The shoot length (cm) in the cotton crop of the study area with 450 ppm 61.1±12.6, 500 ppm 64.9±14 and 550 ppm 73.9±10.8. Significant difference was found ($P<0.05$). The average shoot length of Tur plant under the ambient OTC is 94.5 ±12.8 and ambient field is 93.1±12.3. The shoot length (cm) in the Tur crop of the study area with 450ppm 99.2±16.2, 500 ppm 99.3±18.1 and 550 ppm 109±15.7. No Significant difference was found. The average shoot length of Moong plant under the ambient OTC is 41.5±2.8 and ambient field is 39.8±2.1.

Although there was no significant difference in the shoot length (cm) in the Tur, but there was significant and noticeable change in the shoot length (cm) of Cotton.

Table 3. The average number of leaves in the crop plant in the study area. The average number of leaves of Cotton plant under the ambient is presented in Table 6.15. It shows that OTC is 38.5 ±7.1 and ambient field is 36.3±6.4 respectively. The number of leaves in the cotton crop of the study area with 450ppm 40.8±8.5, 500ppm 49.3±18.5 and 550ppm 62.8±17.0. Significant difference was found ($P<0.05$). The average number of leaves of Tur plant under the ambient OTC is 110.4±11.7 and ambient field is 108.5±10.9. The number of leaves in the Tur crop of the study area with 450 ppm 116.0±13.9, 500ppm 122.0±19.9 and 550ppm 132.5±17. Significant difference was found ($P<0.05$).

There was significant and noticeable change in the number of leaves of both Cotton and Tur.

Table 4. The average number of fruits on the crop plant in the study area is presented in Table 6.16. The average impact of the elevated CO_2 concentration on the number of fruits on the cotton plant under the ambient OTC is 25.7±1.9 and ambient field is 24.2±1.6. The number of fruits on the cotton crop of the study area with 450ppm 21.2±0.8, 500ppm 18.6±1.0 and 550ppm 17.4±0.5. Significant difference was found (<0.05). The average impact of the elevated CO_2 concentration on the number of fruits on the Tur plant under the ambient OTC is 141.3±14.0 and ambient field is 139.7±12.0. The number of fruits on the Tur crop of the study area with 450ppm 132.2±9.0, 500ppm 111.8±3.8 and 550ppm 104.5±3.4 Significant difference was found ($P<0.05$).

There was significant and noticeable difference in the number of fruits on the Cotton and Tur crops, in the study area.

CONCLUSION:

At 450 ppm, 500 ppm and 550 ppm of CO_2 concentration there was no significant difference in the root length (cm) in the Cotton but there was significant and noticeable change in the root length (cm) of Tur crop, there was no significant difference in the shoot length (cm) in the Tur but there was significant and noticeable change in the shoot length (cm) of Cotton and there was no significant difference in the number of leaves in the Groundnut crops but there was significant and noticeable change in the number of leaves of Cotton and Tur in OTC.

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Root length (cm)

Table 1. Impact of the elevated CO_2 concentration on the Root length (cm) of the crops in the study area on onset of reproductive growth.

	CO_2 ppm	N	Mean	SD	SE	Min.	Max.	F	Sig.
Cotton	Ambient OTC	5	7.5	±0.3	0.1	7.1	7.8	1.898	**<0.05**
	Ambient Field	5	7.3	±0.4	0.1	6.8	7.7		
	450	5	8.5	±0.4	0.2	8.0	9.0		
	500	6	8.8	±0.2	0.1	8.5	9.1		
	550	4	8.9	±0.2	0.1	8.7	9.1		
Tur	Ambient OTC	5	7.6	±0.4	0.2	6.9	7.9	8.241	**<0.05**
	Ambient Field	5	7.5	±0.3	0.1	7.1	7.9		
	450	5	8.6	±0.7	0.3	7.8	9.5		
	500	6	9.9	±0.6	0.2	9.4	11.0		
	550	4	10.5	±0.9	0.4	9.9	11.8		

Table 2: Impact of the elevated CO_2 concentration on the Shoot Length (cm) of the crops in the study area on onset of reproductive growth

	CO_2 ppm)	N	Mean cms	SD	SE	Min.	Max.	F	Sig.
Cotton	Ambient OTC	5	58.4	±10.1	3.2	56	60	1.143	<0.05
	Ambient Field	5	56.1	±9.8	2.8	54	57		
	450	5	61.1	±12.6	5.6	46	78		
	500	6	64.9	±14.0	5.7	50	85		
	550	4	73.9	±10.8	5.4	61	86		
Tur	Ambient OTC	5	94.5	±12.8	4.2	92	98	.487	NS
	Ambient Field	5	93.1	±12.3	5.3	89	97		
	450	5	99.2	±16.2	7.2	80	120		
	500	6	99.3	±18.1	7.4	82	124		
	550	4	109.0	±15.7	7.9	91	125		

Table 3: Impact of the elevated CO_2 concentration on the number of leaves (Nos.) on the plant on onset of reproductive growth

	CO_2 (ppm)	N	Mean	SD	SE	Min.	Max.	F	Sig.
Cotton	Ambient OTC	5	38.5	±7.1	2.1	35	40	2.250	<0.05
	Ambient Field	5	36.3	±6.4	1.9	34	39		
	450	5	40.8	±8.5	3.8	28	50		
	500	6	49.3	±18.5	7.6	30	77		
	550	4	62.8	±17.0	8.5	44	84		
Tur	Ambient OTC	5	110.4	±11.7	4.3	108	114	1.010	<0.05
	Ambient Field	5	108.5	±10.9	3.9	106	110		
	450	5	116.0	±13.9	6.2	98	136		
	500	6	122.0	±19.9	8.1	102	148		
	550	4	132.5	±17.1	8.6	109	149		

Table 4: Impact of the elevated CO_2 concentration on the number of fruits on the crop plant in the study area.

	CO_2 (ppm)	**N**	**Mean**	**SD**	**SE**	**Min.**	**Max.**	**F**	**Sig.**
Cotton	Ambient OTC	5	25.7	±1.9	0.6	22	27	164.026	**<0.05**
	Ambient Field	5	24.2	±1.6	0.4	21	26		
	450	5	21.2	±0.8	0.4	17	19		
	500	6	18.6	±1.0	0.4	25	28		
	550	4	17.4	±0.5	0.3	27	28		
Tur	Ambient OTC	5	141.3	±14.0	4.1	137	144	80.942	**<0.05**
	Ambient Field	5	139.7	±12.0	3.5	136	142		
	450	5	132.2	±9.0	4.0	100	125		
	500	6	111.8	±3.8	1.6	150	160		
	550	4	104.5	±3.4	1.7	150	158		