

Adaptive Responses of *Cassia tora* L. in Terms of Seed Morphology and Germination at Some Gas Flaring Sites at Sivasagar District of Assam, India

Bitopan Sarma, Sanjay Kumar Chanda,
Mantu Bhuyan

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Abstract The present study mainly investigated the impact of gas flaring upon seed biology of *Cassia tora* L. plant close to the Gas gathering station (GGS) of Sivasagar, Assam India. Two different seed types, one dormant (Type B) and another non-dormant (Type A) of *C. tora* performed various trend in terms of germination behavior, seed size, weight and production at the studied experimental sites. Analysis of results concluded that *C. tora* plant growing close to the gas gathering stations performed adaptive response in terms of seed biology and produced more dormant seed with hard coat for future survival.

Keywords *Cassia tora*, Gas flaring, Elevated CO₂, Seed germination.

Introduction

Seed germination play crucial role in adaptation, growth and development of plant under stress condition [1]. However, correlation of germination and life strategies of plant is still a cryptic fact in reproductive biology [2]. Seed dormancy is one of the crucial event of plant prevents germination of a seed at an inappropriate time hence play significant role in terms of survival of the plant [3]. Plants perform different types of seed dormancy and may produce different seed types as a part of adaptive response [4]. In general, size of seed is crucial for plant in terms of survival during nutrient-limited conditions and large one get advantages over small one [5]. However, to tolerate stress condition, dormant seed avoided germination as part of evolution. Among the drivers of recent climatic fluctuation, flaring of natural gas play crucial role in boosting the level of carbon dioxide concentration in atmosphere. Recent fluctuation trend of environmental carbon dioxide concentration which altering the temperatures scale in a drastic way is a cause of concern for crop productivity and ecosystem health [6]. North Eastern part of India has is rich in natural oil resource and for extractions of natural oil, several crude oil exploration units and natural gas flaring sites are established. Crude oil exploration units are concentrated in nearby human habitats, rice fields or tea plantation areas of upper Assam and people have already witnessed severe impact of emissions from gas flaring stations on rice as well as tea produc-

B. Sarma*
Academy of Scientific and Innovative Research, CSIR-NEIST
Campus, Jorhat, Assam, India

S. K. Chanda, M. Bhuyan
MAEP Group, CSIR-North East Institute of Science and
Technology, Jorhat, Assam, India
e-mail: mantubhuyan@gmail.com

*Correspondence

Table 1. Annual aerial environmental quality of CO₂, SO₂, temperature and relative humidity at different experimental sites. $F_{2,57}$ 1507.3454176.265632.261 18610.921, P value <0.001 ; <0.001; <0.001; <0.001.

	Annual average of environmental quality of experimental sites			
	CO ₂ (ppm)	SO ₂ (ppm)	Temperature (°C)	Relative humidity (%)
GGS I	569.50 ± 3.00	2.32 ± 0.029	34.24 ± 0.07	45.27 ± 0.96
GGS II	557.50 ± 2.95	2.20 ± 0.018	34.00 ± 0.10	47.00 ± 0.68
Control	400.05 ± 0.27	0.014 ± 0.001	29.26 ± 0.14	74.09 ± 0.171

tion [7]. Contamination of pollutants via air is supposed to be more severe in terms of global environmental effect. Hence, to understand the impact of aerial emission, mainly CO₂ upon the biology of plant growing close to the various flaring sites of upper Assam region, there is an urgent need of a systematic investigation. For this purpose, *Cassia tora* L. a dominant weed belongs to fabaceae family and supposed to be one of the stress tolerant species distributed in the entire region of India was selected. The present study emphasised on the impact of natural gas, flaring upon seed biology of *Cassia tora*.

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Materials and Methods

To study the impact of gas flaring upon *C. tora* two Gas gathering stations (GGSs) of Oil and Natural Gas Corporation (ONGC) in Sivasagar district of Assam was selected. For control (non-polluted) a pollution free sites was selected at Experimental Farm of CSIR-North Eastern Institute of Science and Technology, Jorhat, Assam. To study air quality, measurements were taken by SO₂ Mobile Sensor, CO₂ Mobile Sensor and humidity and temperature meter (Testo Pvt. Ltd, Germany). After maturation and ripening of seed, pod was collected randomly from all the plant growing experimental sites. Collected seeds were categorized into two groups i.e. Type A and Type B for each site and studied accordingly. To study the impact of gas flaring upon seed biology of the representative plant, freshly harvested mature seeds of *Cassia tora* were collected from different experimental sites dur-

ing the month of November to January. Seeds were submerged in water for 48 h separately and after 2 days floating seeds were removed. Healthy seeds were transferred to petri dishes (20 seeds/dish) lined with damp Whitman No. 1 filter paper, placed in a BOD at (32°C ± 2) and checked germination in a daily basis. Seed weight of per 1000 seeds collected plant from different sites was recorded. Emergence of the radicle considered as the criterion for germination. Germinated seeds were counted and removed daily at an interval of 24 h for 7 days under a safe green light filter. To study viability of seed collected from different experimental sites, tetrazolium or triphenyl tetrazolium chloride (TTC) test applied. One way ANOVA is using with Sigma Plot statistical software v13 (Jandel Scientific, San Rafael, CA).

Results and Discussion

Annual maximum average (569.50 ± 3.00) ppm volume of CO₂ and (34.24 ± 0.07) °C temperature was documented at GGS I followed by GGS II in compare to control (Table 1). In terms of SO₂ concentration GGS I performed most followed by GGS II, in compare to control (0.014 ± 0.001) ppm. Burning natural gas may be the cause behind the elevation of carbon dioxide and sulfur dioxide concentration. Minimum humidity (45.27 ± 0.96) % was recorded towards close to the flaring point (Table 1) which may be the simultaneous effect of elevation of carbon dioxide and temperature and sulfur dioxide hence performed less humid condition. Two morphologically different seed types was observed during the study at all the experimental sites and denoted by Type A for big one and Type B for small one. Seed dormancy is supposed to be an adaptive response of plant [8] and documentation of seed dormancy in terms of presence or absence of germination supposed to be the first step [2]. In our observation, in respect to seed types, production of Type

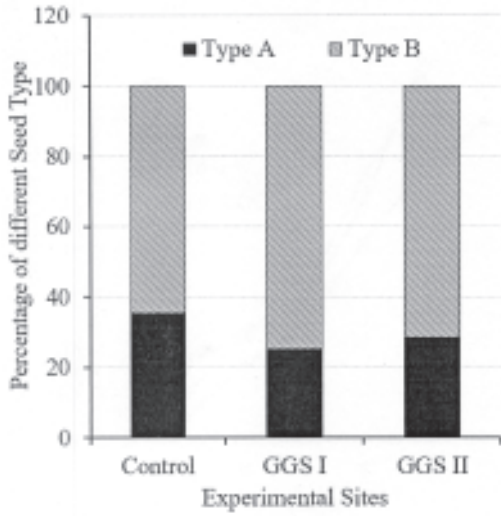


Fig. 1. Production (%) of two types of seed at different experimental sites.

B seed was observed more in all the experimental sites in compare to Type A (Fig. 1). The studied plant may certainly evolved some of their morphological as well as physiological traits and produced more dormant type through which it may cope up all the adverse environmental stress. However, under enriched CO₂

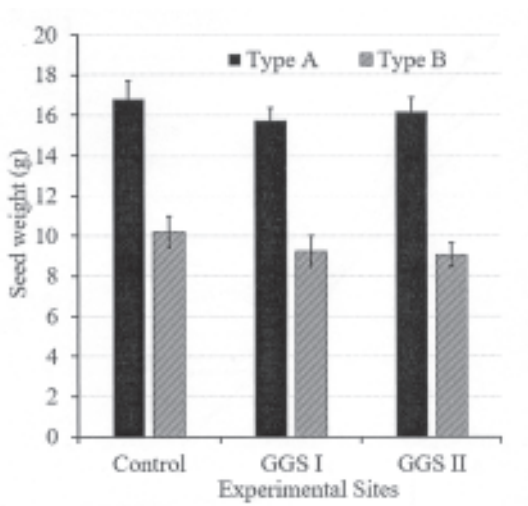


Fig. 2. Seed weight (g) of two seed types at different experimental sites.

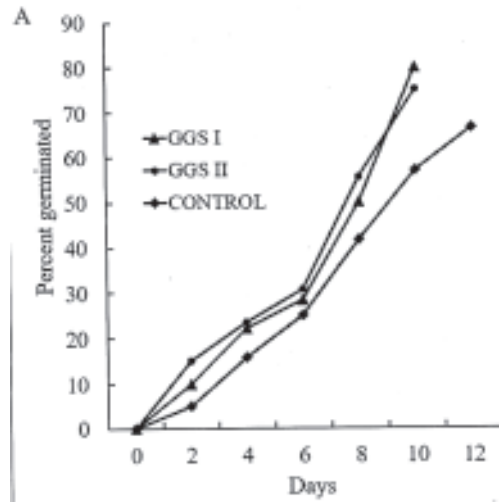


Fig. 3. Seed germination (%) of Type A seed at different experimental sites.

condition, plant performed species specific response in terms of seed production [9]. Seed weight was varied according to their type. Type A seed was heavier with bigger in size than Type B at all the experimental sites (Fig. 2). Seed germination percentage is an important trait varied in respect to seed type. Germination percentage of Type A seed was observed most (80%) at GGS I followed by GGS II(75%) in compare to

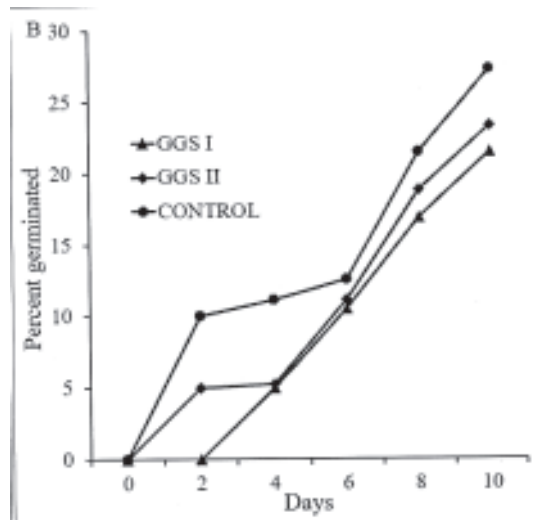


Fig. 4. Seed germination (%) of Type B seed at different experimental sites.

control (66.6%) (Fig. 3). However, in terms of small sized seed i.e. Type B performed most at control (27.27%) and diminished germination percentage in respect to GGS I (21.43%) and GGS II (23.3%) was observed at seed collected from both the flaring sites (Fig. 4). Seeds collected from all the experimental sites were observed viable hence hard and thick coating of seed may be a part of adaptive response of the plant under stress condition. In future, more research in terms of *Cassia tora* plant is required to know the mechanisms behind the seed.

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