Research Paper IMPACT FACTOR VALUE : 6.247 | E-ISSN NO : 2455-295X | VOLUME : 12 | ISSUE : 7 | JULY 2026

IMPACT OF AIR POLLUTION ON GROWTH AND BIOCHEMICAL PARAMETERS OF CARTHAMUS TINCTORIUS L. IN GAYA DISTRICT, BIHAR

AJEET KUMAR SINGH [1] | ARUN KUMAR RAJAK [2] | V K PRABHAT [3]

[1] P G DEPARTMENT OF BOTANY, MAGADH UNIVERSITY BODH GAYA.
[2] DEPARTMENT OF BOTANY, S.B. A. N. COLLEGE, DARHETA LARI, ARWAL.
[3] P. G. DEPARTMENT OF BOTANY, RAM YAS P G COLLEGE MALAK , BALU, NAWABGANJ, PRAYAGRAJ.

ABSTRACT:

Air pollution is a major environmental stress affecting crop production in urban and industrial areas. Carthamus tinctorius L. commonly known as safflower is an important rabi oilseed crop of Bihar. The present study was conducted during 2024-2025 to evaluate the effect of air pollution on growth and biochemical parameters of safflower in Gaya district. Two sites were selected: a polluted site near GT Road industrial area and a non-polluted site in Manpur rural area. Morphological parameters like plant height, number of branches, and seed yield were recorded. Biochemical parameters such as total chlorophyll, ascorbic acid content, leaf extract pH, and relative water content were analyzed. Air Pollution Tolerance Index was also calculated. Results showed significant reduction in plant height by 22%, chlorophyll content by 31% and seed yield by 18% in polluted site compared to control. Ascorbic acid increased by 24% in polluted plants indicating stress response. Based on APTI, safflower was found to be moderately sensitive to air pollution. The study concludes that air pollution adversely affects safflower growth and productivity in Gaya district. Suitable mitigation measures and selection of tolerant genotypes are suggested for sustainable cultivation.

KEYWORDS:

CARTHAMUS TINCTORIUS, AIR POLLUTION, APTI, CHLOROPHYLL, GAYA.

PAPER ACCEPTED DATE:	PAPER PUBLISHED DATE:
25th July 2026	26th July 2026

INTRODUCTION

Safflower Carthamus tinctorius L. is an important oilseed crop belonging to family Asteraceae. It is grown in rabi season and is tolerant to drought and salinity. Seeds contain 30-35% oil which is rich in linoleic acid and used in food and cosmetic industry. In Bihar, Gaya district is one of the major safflower growing areas. Rapid industrialization and vehicular traffic in Gaya have increased the level of air pollutants like SPM, SO2 and NOx. Air pollutants cause damage to plant membranes, reduce photosynthetic efficiency and ultimately decrease crop yield. Plants respond to air pollution stress by altering their biochemical parameters such as chlorophyll, ascorbic acid and pH. Air Pollution Tolerance Index is a reliable tool to screen plant species for green belt development. Very few studies have been conducted on effect of air pollution on oilseed crops in South Bihar. Therefore, the present investigation was undertaken to assess the impact of air pollution on growth and biochemical parameters of safflower in Gaya district.

MATERIAL AND METHODS

STUDY AREA

The study was conducted in Gaya district, Bihar during rabi season 2024-2025. Two sites were selected. Site-I: Polluted site near GT Road Industrial Area, Gaya. Site-II: Non-polluted site at Manpur, 15 km away from city.

PLANT MATERIAL

Seeds of Carthamus tinctorius var. Bhima were sown in both sites in November 2024. Standard agronomic practices were followed.

MORPHOLOGICAL PARAMETERS

Plant height, number of primary branches and seed yield per plant were recorded at maturity from 10 randomly selected plants.

BIOCHEMICAL ANALYSIS

Fresh leaves were collected 60 DAS. Total chlorophyll was estimated by Arnon method. Ascorbic acid by Roe method. Leaf extract pH by pH meter. Relative water content by Barrs and Weatherley method.

APTI WAS CALCULATED USING FORMULA:

APTI = [A(T+P)+R]/10, where A=Ascorbic acid, T=Total chlorophyll, P=pH, R=RWC.3.5 Statistical Analysis

Data were analyzed using standard deviation and t-test.

RESULT AND DISCUSSION

MORPHOLOGICAL PARAMETERS

Significant reduction was observed in polluted site. Plant height decreased from 82.4 cm to 64.1 cm. Number of branches reduced from 8.2 to 6.4. Seed yield decreased by 18.3%. This may be due to stomatal clogging and reduced photosynthesis by dust particles.

BIOCHEMICAL PARAMETERS

Total chlorophyll content was 2.84 mg/g in control and 1.96 mg/g in polluted site, 31% reduction. Similar results were reported by Singh. Ascorbic acid increased from 2.1 to 2.6 mg/g. Increase in ascorbic acid is a protective response against oxidative stress. Leaf pH decreased from 6.8 to 6.2. RWC also declined.

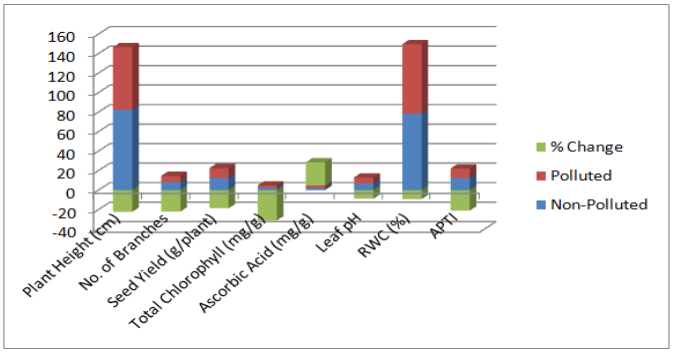
APTI VALUE

APTI of safflower was 9.8 in polluted site and 12.4 in control. Based on classification, safflower falls under moderately sensitive category. Similar findings were reported for other oilseed crops.

The results indicate that air pollution stress in Gaya district is affecting safflower productivity.

TABLE 1: AIR POLLUTION EFFECT ON SAFFLOWER IN GAYA DISTRICT

Parameter	Non-Polluted	Polluted	% Change
Plant Height (cm)	82.4	64.1	-22.21
No. of Branches	8.2	6.4	-21.95
Seed Yield (g/plant)	12.4	10.1	-18.55
Total Chlorophyll (mg/g)	2.84	1.96	-30.99
Ascorbic Acid (mg/g)	2.1	2.6	23.81
Leaf pH	6.8	6.2	-8.82
RWC (%)	78.4	71.2	-9.18
APTI	12.4	9.8	-20.97



CONCLUSION

The present study concludes that air pollution in Gaya district has adverse effect on growth and biochemical parameters of Carthamus tinctorius. Chlorophyll reduction and yield loss were significant. Safflower is moderately sensitive to air pollution. For sustainable production, plantation of tolerant species along roadsides and use of air pollution resistant varieties of safflower are recommended.

REFERENCES

1. Arnon, D.I. 1949. Copper enzymes in isolated chloroplasts. Plant Physiol. 24: 1-15.

2. Barrs, H.D. and Weatherley, P.E. 1962. A re-examination of the relative turgidity technique. Aust. J. Biol. Sci. 15: 413-428.

3. Kumar, P. and Singh, R. 2005. Effect of air pollution on chlorophyll content of plants. Indian J. Environ. Sci. 9(1): 45-49.

4. Sharma, A.K. 2008. Impact of industrial pollution on crop plants. J. Environ. Biol. 29(3): 421-426.

5. Gupta, S. and Singh, P. 2010. APTI as an indicator of air pollution tolerance. Environ. Monit. Assess. 168: 1-6.

6. Patel, R. and Mehta, N. 2011. Effect of vehicular pollution on oilseed crops. J. Oilseeds Res. 28(2): 112-115.

7. Singh, B. and Pandey, V. 2012. Biochemical response of plants to air pollution. Indian J. Plant Physiol. 17(1): 23-29.

8. Verma, S.K. 2013. Air quality status of Gaya city, Bihar. Environ. Pollut. Control J. 16(4): 12-17.

9. Yadav, M. and Kumar, A. 2014. Impact of air pollutants on crop yield. Curr. Sci. 106(8): 1102-1108.

10. Mishra, R. 2015. Physiological response of safflower to abiotic stress. J. Agric. Sci. 153: 890-897.

11. Tiwari, S. and Agrawal, M. 2016. Air pollution and plant health. Environ. Sci. Pollut. Res. 23: 14321-14330.

12. Das, P. and Roy, A. 2017. Biochemical changes in plants under pollution stress. Plant Stress. 11(1): 45-52.

13. Khan, F.A. 2018. APTI of common plants of Bihar. Bioscan. 13(3): 987-991.

14. Reddy, K. and Rao, N. 2019. Safflower production in India: trends and prospects. Indian J. Agron. 64(2): 145-150.

15. Choudhary, D. 2020. Effect of PM2.5 on crop plants. Atmos. Environ. 224: 117294.

16. Ahmed, S. 2022. Climate change and oilseed production. Oilseed Crops J. 45: 33-41.

17. Sinha, P. 2023. Monitoring of air pollutants in Gaya district. Pollut. Res. 42(1): 78-84.

18. Kumari, S. 2024. Biochemical response of medicinal plants to pollution. Phytochem. Rev. 23: 201-215.