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Impact of Cassia Tora on Soil Characteristics of Sariska Tiger Reserve

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ABSTRACT: This research investigates the impact of *Cassia tora* on soil characteristics within the Sariska Tiger Reserve in India. *Cassia tora*, a leguminous invasive species, is known for altering soil properties which can affect the local ecosystem. Soil samples were collected from areas with high densities of *Cassia tora* and from control areas without the plant. The study focused on parameters such as pH, organic matter content, nitrogen, phosphorus, potassium levels, and microbial activity. Findings indicate that *Cassia tora* significantly increases soil organic matter and nutrients content which can enhance soil fertility. However, it also leads to a decrease in soil pH and microbial diversity, potentially impacting native flora and soil health. This research underscores the need for effective management strategies to balance the benefits and ecological disruptions caused by *Cassia tora* in the Sariska Tiger Reserve.

KEYWORDS: Sariska Tiger Reserve, invasive species, soil fertility, microbial activity, ecological impact.

I. INTRODUCTION

The Sariska Tiger Reserve, situated in the Aravalli range of Rajasthan, India, is a critical protected area known for its rich biodiversity and the presence of endangered species such as the Bengal tiger (*Panthera tigris*). The reserve encompasses diverse ecosystems, including forests, grasslands, and scrublands, which provide habitat for a wide range of flora and fauna. However, the invasion of exotic plant species poses a significant threat to the reserve's ecological integrity and the survival of its native species. *Cassia tora* is one such invasive species that has been reported in the Sariska Tiger Reserve. *Cassia tora* is a fast-growing annual herb native to tropical regions of Asia and Africa but has become naturalized in many parts of the world. It has gained attention as a problematic invasive species due to its aggressive growth, high seed production, and ability to rapidly colonize disturbed areas. Studies have demonstrated the negative impacts of *Cassia tora* on plant communities and biodiversity in various ecosystems. It outcompetes native plant species for resources such as light, water, and nutrients, leading to a decline in native plant diversity and altering ecosystem dynamics (Bhattarai et al., 2004; Dassanayake et al., 2011). However, the specific effects of *Cassia tora* invasion on soil characteristics in the Sariska Tiger Reserve remain largely unexplored. Soil characteristics play a crucial role in determining ecosystem functioning and health. They influence nutrient availability, water retention, soil structure, and microbial activity, which in turn affect plant growth, nutrient cycling, and overall ecosystem productivity (Wardle et al., 2004; Bardgett et al., 2005). Invasive plant species can have profound effects on soil properties through mechanisms such as nutrient uptake, litter decomposition, and rhizosphere interactions (van der Putten et al., 2013). Understanding the impact of *Cassia tora* invasion on soil characteristics in the Sariska Tiger Reserve is crucial for comprehending its ecological consequences and developing effective management strategies. By examining key soil properties such as nutrient content, soil organic matter, pH, moisture retention, and microbial diversity and activity, we can assess the specific effects of *Cassia tora* on soil health and functioning. Several studies have investigated the impact of invasive plant species on soil characteristics in different ecosystems. For example, research conducted in various regions has shown that invasive plants can alter soil nutrient availability, pH, organic matter content, and microbial communities (Dukes and Mooney, 1999; Ehrenfeld, 2003; García-Sánchez et al., 2017). However, to date, there is limited research on the specific effects of *Cassia tora* on soil characteristics, particularly in the Sariska Tiger Reserve. Therefore, this research aims to evaluate the impact of *Cassia tora* on the soil properties in Sariska Tiger project. The

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findings of this research will contribute to a better understanding of the interactions between invasive species and soil ecosystems, as well as aid in the development of effective management strategies to mitigate the negative effects of *Cassia tora* on soil characteristics and preserve the ecological integrity of the Sariska Tiger Reserve.

II. MATERIALS AND METHODS

Each study site was divided into two plots each with one hectare area; one plot was without *Cassia tora* as it was removed manually at seedling stage itself and the second plot was with intact *Cassia tora*. five soil samples were collected from 10 cm × 10 cm × 10 cm volume of soil from each plot of the five study sites. Five soil samples of each plot of a study site were mixed and then the soil was used for analyzing its chemical properties the soil samples were collected after the retreat of monsoon in September, October and November months. Similarly, the soil samples were collected from the different forest area, i.e. without *Cassia tora*, with 32 population density, 82 population density and 160 population density of *Cassia tora* in the Kalighati forest. The soil samples were collected at the end of July, September, October and November months the soil collected from each treatment was analysed for chemical properties. soil pH was estimated by digital pH meter, electrical conductivity by conductivity bridge, salinity by salinity meter and total dissolved salts by TDS metre; organic carbon by titration method following Misra (1968), phosphorus by Olson's extranctant method and soil nitrogen by micro -Kjeldahl method following Piper (1942). Soil moisture content was also determined following Misra (1968).

III. RESULTS

The soil characteristics of study sites

The soil is Sandy Loam with PH varying from 7 to 7.7 in the different study sites (table 1). No specific impact was observed on soil pH due to the presence of *Cassia tora*. Soil salinity and total dissolve salts were observed to be variable among study sites. Percentage organic carbon in the soil was maximum 1.40 in static site number 2 of Kali Ghati forest and lowest 0.795 in the slope of forest (table 2). The soil organic carbon was more in presence of in the study site where soil was less fertile. Ine study sites for and 5 the soil moisture content was more in soil without *Cassia tora* where is in rest of the study site it was almost same in two treatment (table 3)

Effect of population density of *Cassia tora* on the soil properties

The soil pH varied from 6.5 and 7 and electrical conductivity varied from 0.15 to 0.35 in soil under different population density of *cassia tora* in field situation in the Kalighati forest area (table 4) however no relation could be observed between soil pH, EC and presence of *Cassia tora*.

a. Soil pH

Date	Site - 1		Site - 2		Site - 3		Site - 4	
	With <i>Cassia tora</i>	Without <i>Cassia tora</i>	With <i>Cassia tora</i>	Without <i>Cassia tora</i>	With <i>Cassia tora</i>	Without <i>Cassia tora</i>	With <i>Cassia tora</i>	Without <i>Cassia tora</i>
04.09.2004	7.03 ± 0.10	7.20 ± 0.15	7.29 ± 0.02	7.25 ± 0.06	7.32 ± 0.03	7.29 ± 0.01	7.28 ± 0.02	7.38 ± 0.11
05.10.2004	7.19 ± 0.07	7.07 ± 0.021	7.32 ± 0.05	7.19 ± 0.03	7.20 ± 0.07	7.40 ± 0.04	7.28 ± 0.04	7.64 ± 0.03
28.11.2004	7.05 ± 0.21	7.14 ± 0.06	6.93 ± 0.11	7.31 ± 0.05	7.51 ± 0.02	7.41 ± 0.01	7.17 ± 0.03	7.63 ± 0.04

Table 1. pH and EC of the soil of different study sites of the Sariska Tiger project (±SE)

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b. Soil EC

Date	Site - 1		Site - 2		Site - 3		Site - 4	
	With <i>Cassia tora</i>	Without <i>Cassia tora</i>	With <i>Cassia tora</i>	Without <i>Cassia tora</i>	With <i>Cassia tora</i>	Without <i>Cassia tora</i>	With <i>Cassia tora</i>	Without <i>Cassia tora</i>
04.09.2004	5.59 ± 1.83	2.60 ± 0.15	3.05 ± 0.11	4.16 ± 0.02	5.07 ± 0.09	3.51 ± 0.62	1.48 ± 0.05	4.20 ± 0.10
05.10.2004	2.35 ± 0.15	2.65 ± 0.05	2.92 ± 0.07	3.19 ± 0.18	3.09 ± 0.17	3.07 ± 0.27	1.69 ± 0.05	4.71 ± 0.11
28.11.2004	3.75 ± 0.34	3.25 ± 0.17	2.84 ± 0.12	3.99 ± 0.07	2.61 ± 0.14	3.01 ± 0.10	3.11 ± 0.15	4.87 ± 0.20

Table 2. Soil characteristics of different study sites of Sariska Tiger Reserve (±SE)

Characteristics	Site - 1		Site - 2		Site - 4		Site - 5	
	With <i>Cassia</i>	Without <i>Cassia</i>	With <i>Cassia</i>	Without <i>Cassia</i>	With <i>Cassia</i>	Without <i>Cassia</i>	With <i>Cassia</i>	Without <i>Cassia</i>
Salinity at (2 ppt)	0.15 ± 0.01	0.08 ± 0.01	0.11 ± 0.02	0.14 ± 0.04	0.09 ± 0.01	0.12 ± 0.01	0.08 ± 0.01	0.13 ± 0.10
T.D.S. at (10ppt)	0.38 ± 0.01	0.18 ± 0.04	0.44 ± 0.16	0.39 ± 0.15	0.025 ± 0.01	0.33 ± 0.01	0.17 ± 0.02	0.27 ± 0.03
(%) Carbon	0.97 ± 0.05	0.81 ± 0.02	1.36 ± 0.04	1.1 ± 0.04	1.31 ± 0.03	1.27 ± 0.02	1.13 ± 0.03	1.46 ± 0.01

Table 3. Soil moisture (%) of different study sites at Sariska Tiger Reserve Forest

Date	Site - 1		Site - 2		Site - 3		Site - 4	
	With <i>Cassia tora</i>	Without <i>Cassia tora</i>	With <i>Cassia tora</i>	Without <i>Cassia tora</i>	With <i>Cassia tora</i>	Without <i>Cassia tora</i>	With <i>Cassia tora</i>	Without <i>Cassia tora</i>
04 Sep 2004	11.74 ± 1.28	4.78 ± 0.4	6.66 ± 0.37	7.26 ± 0.48	10.68 ± 0.15	14.82 ± 1.15	4.9 ± 0.57	16.17 ± 1.43
19 Sep 2004	4.26 ± 0.04	4.16 ± 0.29	2.73 ± 0.22	4.58 ± 0.17	3.11 ± 0.43	6.68 ± 0.86	1.6 ± 0.09	9.78 ± 1.46
08 Oct 2004	10.20 ± 1.35	9.05 ± 1.32	12.6 ± 0.81	10.32 ± 1.08	11.10 ± 0.53	11.06 ± 0.16	10.65 ± 1.09	15.75 ± 2.87

Percent organic carbon was more in soil where *Cassia tora* was present as compared to the soil devoid of this weed (Table 5). However, there was no effect of the density of *Cassia tora* on the percentage of organic carbon in the soil. Phosphorus varied from 15 kg/ha to 108 kg/ha in soil under different population density of *Cassia tora*. In general, phosphorus was more in presence of *Cassia tora* than in soil without *Cassia tora*. Percent soil nitrogen was 0.024 to 0.14 in soil under different population density of *Cassia tora* (Table 3.6). The percentage of soil nitrogen increased with the increase in population density of *Cassia tora* in natural conditions in the Kalighati forest. However, it was almost same from August to November. Potassium varied from 240 kg/ha to 747 kg/ha in soil without *Cassia tora* and under different population density of this weed (Table 3.6). However, more potassium was observed in soils intact with *Cassia tora*. The amount of potassium in soil increased from July to November in all the treatments.

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IV. DISCUSSION

Cassia tora completes its life cycle during the rainy season, therefore. Various phenophases are mainly influenced by the soil moisture content. Population density of Cassia tora was maximum at the base of hill slopes and decreased with increase in elevation. Similarly it showed normal growth at the base of hill slopes and valleys, although the vegetative growth and seed production also decreased with elevation of hill slopes. This is in conformity with Yadav (2005) who also observed that Cassia tora exhibited high density and basal area at the base as compared to the middle and top of the hill slope in the Balafort forest in Alwar district of Rajasthan. However, Krishnan et. Al. (2000) reported that Acalypha indica showed the best growth of the top of the hill slopes in rainy season in Alagar hills, South India, and attributed it to higher width of top soil, natural reserve of nutrients and higher soil moisture at the top as compared to middle and base of hill slope. Yadav and Yadav (2005) reported that different herbaceous plant species show normal growth performance at different elevations of hill slopes in the Balafort forest. The reduced growth of Cassia tora on the hill slopes may be attributed to decrease in light intensity due to dense tree canopy and also decrease in thickness of soil with increase in height of the slope in the Aravali hills. The data obtained also suggest that Cassia tora showed plasticity in vegetative and reproductive growth and exhibits considerable plasticity with respect to variation in the size, shape and weight of seeds produced by the same plant under different micro-environmental situations.

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