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Research Article

PRELIMINARY FOLIAR STUDIES ON CROP PLANTS NEAR STONE QUARRY SITE

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ABSTRACT

To find out the impacts of stone quarrying on nearby cash crops like Hevea brasiliensis and Artocarpus hirsutus, conducted a comparative study by taking leaf samples from quarry site and non-quarry site. The results shows reduction in leaf area and stomatal index and increase in concentrations of total chlorophyll and phenolics in quarrying area. It is due to the pollution stress imposed by quarrying activity and it leads to productivity decline of the crops.

INTRODUCTION

Quarrying industry is a fast growing one in Kerala, it is necessary for some extent to provide building materials for developmental activities, but the various kind of pollution from quarrying are injurious to nature and its inmates. Several authors including (Loponen, *et al*., 1998) in *Betula pubescence*, (Tiwari, *et al*., 2006) in *Betula pendula*, (Tripathi and Gautham, 2007) in *Mangifera indica* and (Seyyednejad, *et al*., 2009) in *Albezia lebbeck* and *Callistimon citrinus*, demonstrated the negative impacts of quarrying in nearby plants. In Kerala, there are 2700 working quarries of which 1700 are illegal (The Hindu, 2013).

In this study we are trying to demonstrate impacts of quarrying in on nearby trees by comparing foliar features of the trees in quarry site with non quarry site, We have taken two economically important plants, *Artocarpus hirsutus* and *Hevea brasiliensis*, the former one produce edible fruits which have high demand in market, the latter on produce latex commonly known as rubber which is the major cash crop in Kerala.

So many studies are conducted in depicting affect of pollution in plants and studies are also there in types of pollution from quarries. It is the first work which relating affects pollution from quarry in nearby plants (crop plants). We selected trees for the purpose that the herbaceous or shrubby plants can't withstand pollution they die off suddenly. We want to find out whether the trees will give up while facing pollution or they show some adaptive mechanisms and also keenly enthusiastic about the productivity of the crop plant whether affected by the adaptive mechanisms.

Here we are taking leaves for study because the leaf area, chemical composition will directly influence/ demonstrate the productivity of the plant. (Poorter and Jong, 1999)

MATERIAL AND METHODS

The study site is in Pathanamthitta district, Kerala, India (Lat. 9.320804°, Long. 76.660907°) (Fig. 1), data were collected from October 2014 to February 2015. Different aged leaf samples were taken from target species near quarry site and non –quarry site (both are rocky habitats). Leaf area was measured using leaf area meter, stomatal index were found out by peeling epidermal layer and counting cells visually followed by using the formula;

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$$\text{Stomatal index} = \frac{\text{No.of stomata in an area}}{\text{No.of stomata + No.of epidermal cells}} \times 100$$

The total chlorophyll is found out by extracting chlorophyll in 80% acetone and the absorption at 663 nm and 645 nm are red in spectrophotometer, using the absorbtion coefficients the quantity of chlorophyll is calculated. The phenolics concentration found out by measuring intensity of blue colour in spectrophotometer after the samples reaction with Phosphomolybdnic acid in Folin-ciocateau reagent in alkaline medium. One gram of leaf is taken for the biochemical assays. It did in replica and average value is taken.

Compared the results of samples collected from quarry area with the non-quarry area by using independent t-test in SPSS.

RESULTS

Artocarpus hirsutus (Fig. 2) and *Hevea brasiliensis* (Fig. 3) showed significant differences by means leaf area, chlorophyll and phenol content in two conditions, the distinction of stomatal index was not significant Table 1. Leaf area were higher in non quarry site samples, were chlorophyll and phenol content were elevated in quarry site samples.

DISCUSSION

Reduced leaf area might be the result of pollution stress, it has negative impact on the productivity of the crop plant. The smaller leaf area will absorb decreased radiation, and the photosynthetic rate will slow down (Tiwari, *et al*., 2006). In an earlier study conducted on *Betula pendula* showed gradual reduction in stomatal frequency as a phenotypic acclimation to CO_2 increase (Wagner, *et al*., 1996), the stomatal frequency proportional to stomatal index hence the result underlining the affect of quarry pollution in plants. A study done by (Mitchell, 2012) depicts the high rate of CO_2 production from the quarrying process. (Batti and Iqbal, 1988) say that the modification of frequency and size of stomata in response to environmental stress is an important factor controlling the absorption of pollutants by plants.

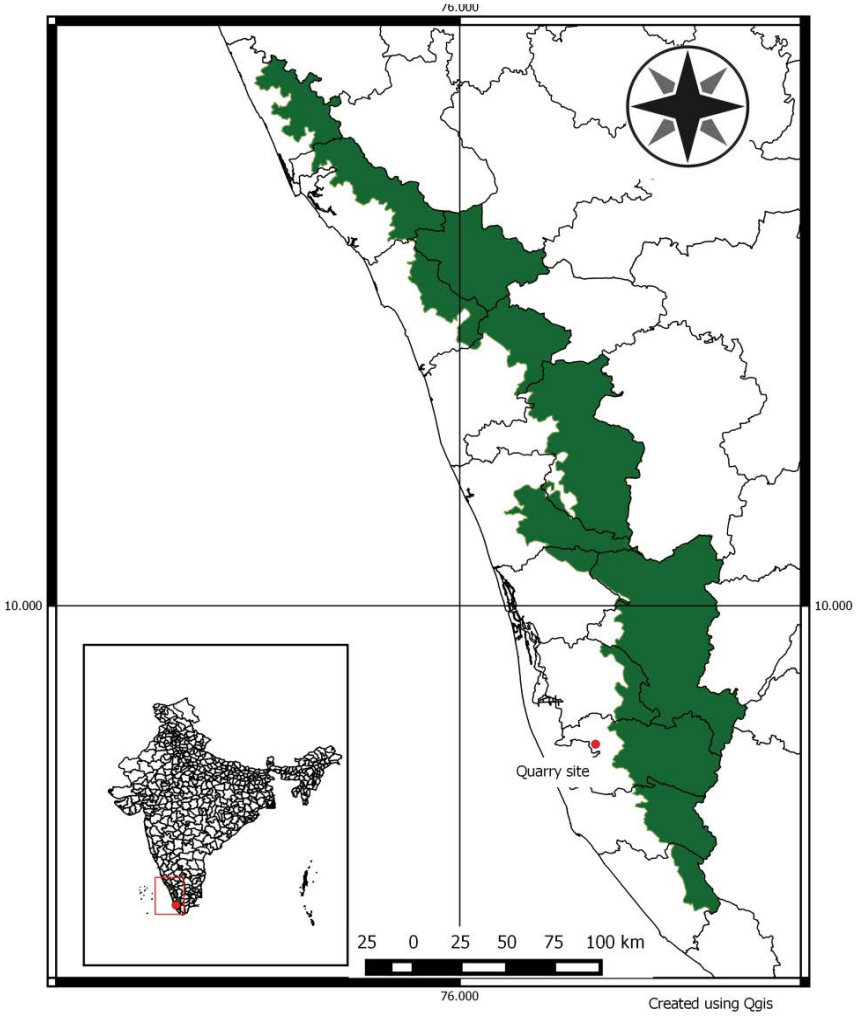

Fig. 1 Study site.

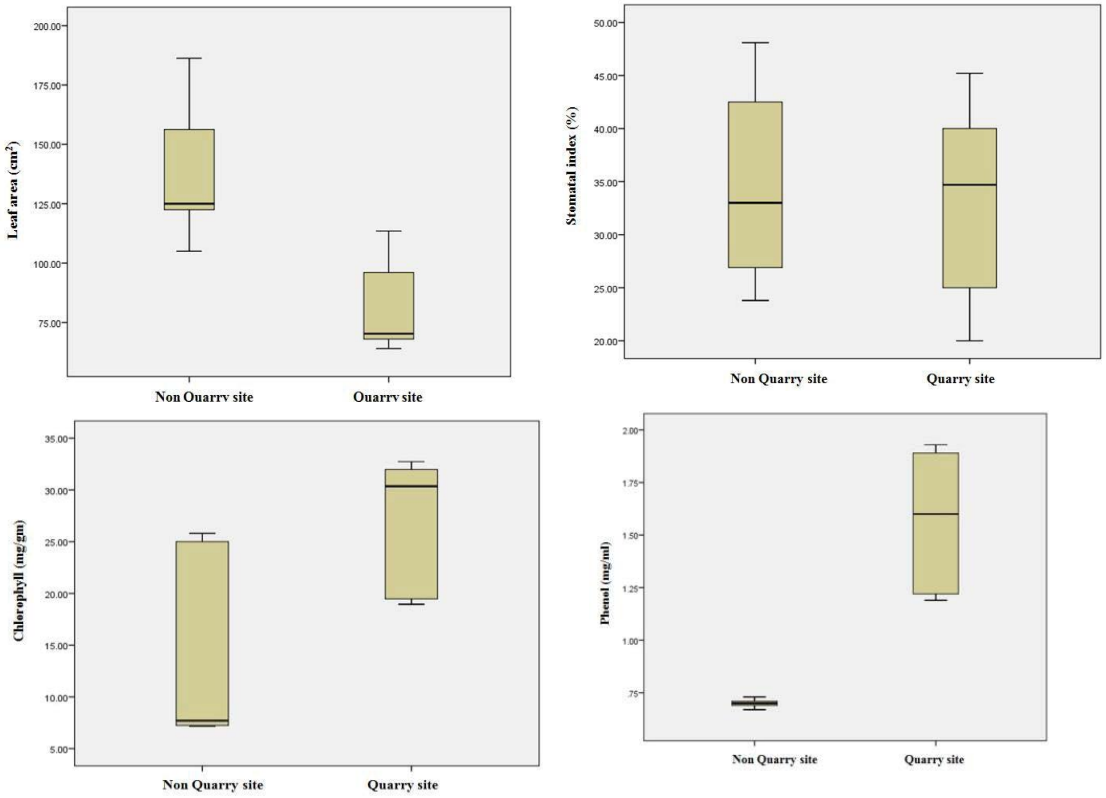

Fig. 2 *Artocarpus hirsutus;* Leaf area, stomatal index, chlorophyll and phenol from quarry and non-quarry sites.

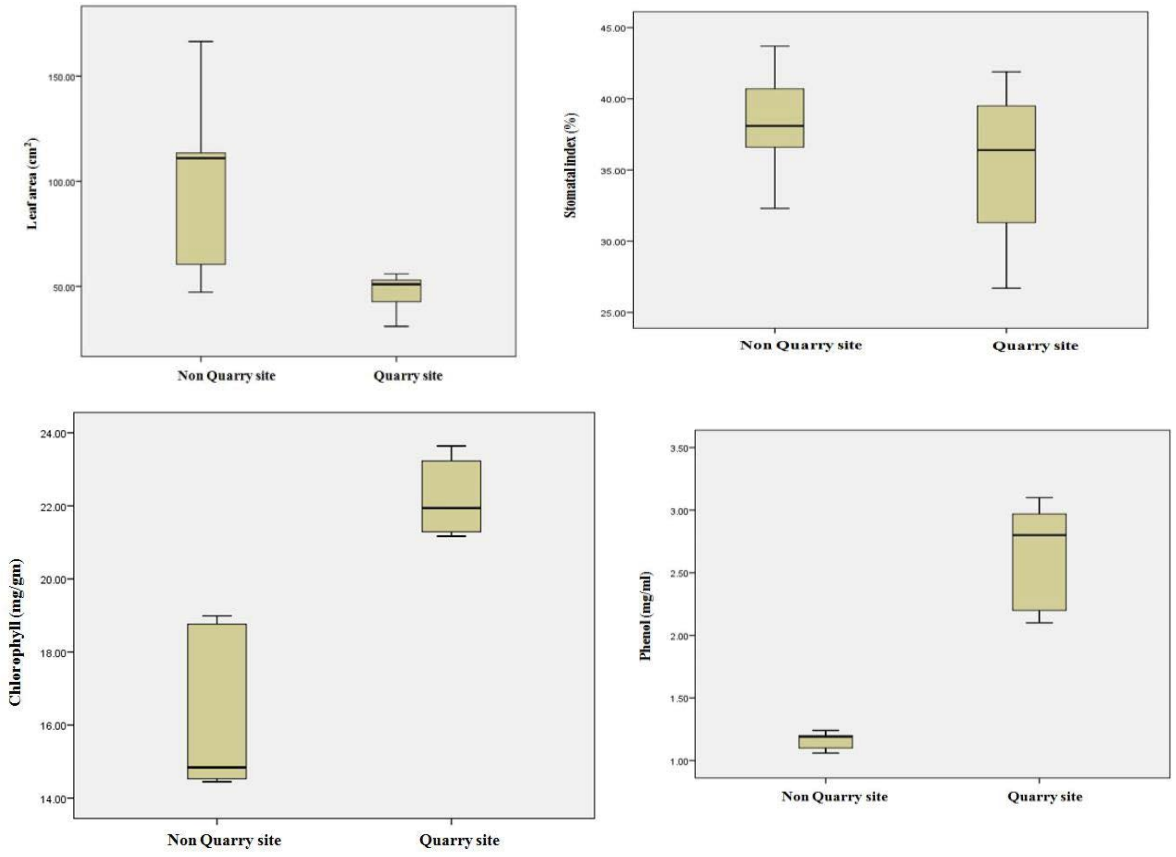

Fig. 3 *Hevea brasiliensis;* Leaf area, stomatal index, chlorophyll and phenol from quarry and non-quarry sites.

Table 1. Independent t-test results for leaf area, stomatal index, chlorophyll and phenol for two species in quarry and non-quarry site. (NS-Non significant, **- Significant at 0.01 confidence level)

Variables		Non Quarry site (Mean ± S.E)	Quarry site (Mean ± S.E)	t-value	p-value
Artocarpus hirsutus	Leaf area (cm^2)	136.97 ± 9.61	82.56 ± 6.25	4.75**	0.0002
	Stomatal index (%)	34.79 ± 3.04	33.19 ± 3.13	0.36^{NS}	0.7185
	Chlorophyll (mg/gm)	13.42 ± 2.98	27.26 ± 2.04	-3.83**	0.0015
	Phenol (mg/ml)	0.699 ± 0.006	1.57 ± 0.102	-8.56**	0.00002
Hevea brasiliensis	Leaf area (cm^2)	100.67 ± 13.07	47.33 ± 2.95	3.94**	0.0035
	Stomatal index (%)	38.13 ±1.37	35.28 ± 1.83	1.25^{NS}	0.2301
	Chlorophyll (mg/gm)	16.07 ± 0.71	22.18 ± 0.32	-7.84**	0.00001
	Phenol (mg/ml)	1.16 ± 0.021	2.68 ± 0.13	-11.14**	0.000003

The elevated chlorophyll content might be due to tolerating or competing activity of plant because of reduced leaf area, higher chlorophyll content implies better photosynthetic rate. Earlier studies also underlines that plants grown in polluted habitat shows higher chlorophyll content, in *Mangifera indica* (Tripathi and Gautham, 2007), *Albezia lebbeck* and *Callistemon citrinus* (Seyyednejad, *et al*., 2009). The resulted higher phenolic content of quarry area sample is clear indication that the plant is under stress, it has negative impact on the productivity of the crop plants selected for the study. Studies in *Betula pubescence* (Loponen, *et al*., 1998) shows elevated phenolic content in polluted area.

Based on the field observations (Fig. 2), the productivity of *Hevea brasiliensis* is very low in the quarry site.

The results indirectly depicting that stone quarry as a source of pollution. The plantations near the quarry site might have some complications which influence the productivity of crops. The *Artocarpus hirsutus* and *Hevea brasiliensis* are adopting some mechanisms to withstand the affect of pollution by reducing leaf area and stomatal index and increasing chlorophyll and phenolics content.

CONCLUSION

The reduced leaf area elevated chlorophyll and phenol content giving a clear indication that the trees are in stress, we concluded that the stress being excerted by nearby working quarry. The declined productivity of these cash crops should be burden for the farmers.

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