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CHLAMYDOSPORE DENSITY WITH RESPECT TO PHYSIO-CHEMICAL PARAMETERS OF SOIL

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ABSTRACT

Solapur district is found to be rich and diverse in flora which has not been studied yet with respect to arbuscular mycorrhizal fungal association. Such diverse vegetation is well supported by AM fungal associations. It plays an important role along with a spectrum of microflora. The present research work was undertaken with a view to understand more about the diversity of arbuscular mycorrhizal fungi in family Euphorbiaceae in the Solapur district.

KEYWORDS: *physicochemical parameters of soil, flora and fauna, management systems.*

INTRODUCTION

To study chlamydospore density during present investigation with respect to physicochemical parameters of soil. 'Random Effects model' of panel data linear regression analysis using 'R' statistical software ("plm" package)- was used. Panel data frame was formulated with cross-section data (individual data entries of each site) and time-series data (seasonal variation during rainy, winter and summer). During panel data analysis, 'pooled OLS', 'between', 'first difference', 'within', 'random effects' models were checked for their 'goodness of fit' to the present data. Among these, the author found 'random effects model' was better fit for this data with 78.39% variance using 'Hausman test' (Table- 33).

Table no. 33
Panel data linear regression model analysis

```
Random<-plm(Chlamydospores~pH+T+Moisture+Lamda+N+P+K+Carbon+Fe,
data=Pnreg, model="random")
>summary(Random)
Oneway (individual) effect Random Effect Model
   (Swamy-Arora's transformation)

Call:
plm(formula = Chlamydospores ~ pH + T + Moisture + Lamda + N +
    P + K + Carbon + Fe, data = Pnreg, model = "random")

Balanced Panel: n = 11, T = 3, N = 33

Effects:
                  var   std.dev  share
idiosyncratic 1831.72   42.80    0.558
individual    1452.57   38.11    0.442
theta: 0.456

Residuals:
    Min.    1st Qu.   Median    3rd Qu.    Max.
-76.7201   -18.1534  -1.0459    22.8043    75.1330
```

```
Coefficients:
              Estimate   Std. Error  z-value   Pr(>|z|)
(Intercept)    979.2318  192.3326     5.0913   3.555e-07 ***
pH            -87.7823   37.3459     -2.3505   0.01875 *
Temp.         -9.4115    1.6703      -5.6346   1.755e-08 ***
Moisture      -15.3692   3.6173      -4.2488   2.149e-05 ***
Ele.Cond.     -5.3388    2.6843      -1.9889   0.04671 *
N             -86.1603   260.8895    -0.3303   0.74121
P              11549     8754.2839    1.3192   0.18709
K             -4.0699    9.9501      -0.4090   0.68252
Org.Carbon     92.5749   18.1857      5.0905   3.571e-07 ***
Fe            -20.8627   4.8618      -4.2911   1.778e-05 ***
---
Signif.codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares:    242920
Residual Sum of Squares: 37729
R-Squared:      0.84469
Adj. R-Squared: 0.78391
Chisq: 125.09 on 9 DF, p-value:< 2.22e-16
```

During this analysis, we examined significant association between chlamydospore density with physico-chemical parameters of soil such as pH, temperature, moisture content, electrical conductivity, nitrogen, phosphorus, potassium, organic carbon and iron. Micro-nutrients like copper, zinc and manganese were omitted from this analysis because they were preliminary tested for their correlation and found not significant.

Soil temperature, moisture content, organic carbon and iron were highly significant and associated with changes in chlamydospore density. pH of soil and electrical conductivity were merely significant. In our observations, the highest number of spore density can be correlated with slightly lower pH than the neutral; while Sidhu and Behl (1997) have reported increase in pH, favours chlamydospore formation. Porter *et al.* (1987) reported that soil pH is known to influence AM fungal distribution. Less than neutral pH was found favourable for AM fungal occurrence (Thaper, 1990; Gillaspie and Pope, 1991).

Organic carbon and chlamydospore density have high degrees of positive correlation. There is 92.57 unit increases in chlamydospore density with 1% increase in Organic carbon. More organic carbon also favours a high population of arbuscular mycorrhizal fungi (Jha *et al.,* 1988). The sites which were covered with more vegetation were found high in organic matter content. This also adds value to the favourable conditions for high spore productivity (Verma and Arya, 1998; Wei *et al.,* 1987). On the contrary, at sites of less vegetation, the arbuscular mycorrhizal fungal occurrence was low, which was mainly due to scanty vegetation and low organic carbon.

Soil temperature and chlamydospore density have negative correlation. There is a 9.41 unit increase in chlamydospore density with 1^{o}C decrease in soil temperature. The overall soil temperature at all sites were in the range of 16.4^{o}C to 36^{o}C, Furlan and Fortin (1973) observed that maximum sporulation of *Glomus calospora* occurred at 21^{o}C night and 26^{o}C day temperatures whereas Schenck and Schroder (1974) reported maximum sporulation of *Gigaspora margarita* on soybean at soil temperature 35^{o}C. Haymann (1974) showed that at 14^{o}C temperature, the growth decreases in *Glomus mosseae.* Menge *et al.* (1979) reported *Glomus fasciculatum* in sudan, temperature over 51.5^{o}C were found lethal.

Moisture content in soil and chlamydospore density has negative correlation. There is 15.37 unit increases in chlamydospore density with 1% decrease in moisture content. The moisture content varied from 19.7% to 42.6%, which also played a major role in arbuscular mycorrhizal fungal flora and native root colonization (Parmeswaran and Augustine, 1988). In the present investigation, the moisture content was very less during summer season, moderate during winter and high moisture content during rainy season.

During winter due to lowering the moisture content, the hyphae which are present outside the root, develop the spores.

Iron content of soil and chlamydospore density also have negative correlation. There is 20.86 unit increases in chlamydospore density with 1 ppm decrease in Iron content.

We observed that Phosphorus has the highest coefficient of correlation i.e. 11549 but it is not significantly associated with chlamydospore density. This may have happened because AM fungal colonization favours phosphate mobilization and uptake (Baylis, 1970; Mosse, 1973; Gerdemann, 1975; Tinker, 1975). Thus, it is an interdependent variable. Phosphorus level is known to influence AM fungal distribution (Michel-Rosales and Valdes, 1996). Low phosphate was found favourable for AM fungal occurrence (Thaper, 1990; Gillaspie and Pope, 1991).

The native flora and fauna sometimes play an important role in determining the soil texture which varied in the present investigation from coarse to silt. Such texture is a characteristic feature of rocky terrain throughout the world. Soil texture is also dependent on parental rock. AM fungal spore population and colonization is also affected by soil texture since soil texture affects drainage of soil, aeration etc. Aeration of substratum was observed favourable for arbuscular mycorrhizal fungal colonization (Tacon *et al.,* 1979; Ikram *et al.,* 1992; Nemec, 1987; Menge, *et al.,* 1979).

Seasonal host colonization patterns were highly correlated with available phosphorus, soil moisture content and source-sink relationships linked to the plants growth stages (Cade-Menun *et al.,* 1991), light (Ekwebelam and Reid, 1983; Suhardi and Darmawan, 1990; McGee, 1990), temperature (Buwalda *et al.,* 1985; Andersen *et al.,* 1987; Klopatek *et al.,* 1988; Borges and Chaney, 1989), pH (Davis *et al.,* 1983; Reid *et al.,* 1988; Gillespie and Pope, 1991; Sidhu and Behl, 1997) and organic carbon (Verma and Arya, 1998; Wei *et al.,* 1987).

The rocky terrain with crevices on plateaus, along with herbaceous vegetation consisting of ephemerals, annual herbs and grasses together provide favourable conditions for AM fungal colonization. Due to this, the spore density at such places is found to be high. It was observed that some of the native plant species were monsoon perennials and most of the other vegetation was in the seasonal category. Both the types of vegetation were dependent on monsoon for their rejuvenation and for the completion of life cycle by the end of winter season. However, it was found that the remnant root system of these plants in the rhizospheric soil was associated with the micro-flora and was also found to play a main role in sustaining their population.

Observations during the present investigation showed that the vegetation cover plays an important role in determining AM fungal community present in the soil. Uhlmann *et al.* (2004) have observed that the arbuscular mycorrhizal fungal community does not appear to be influenced by land management systems, but rather by vegetation cover or rainfall regime.

CONCLUSION

During this analysis, we examined significant association between chlamydospore density with physico-chemical parameters of soil such as pH, temperature, moisture content, electrical conductivity, nitrogen, phosphorus, potassium, organic carbon and iron.

Soil temperature, moisture content, organic carbon and iron were highly significant and associated with changes in chlamydospore density.

Moisture content in soil and chlamydospore density has negative correlation.

AM fungal spore population and colonization is also affected by soil texture since soil texture affects drainage of soil, aeration etc. Aeration of substratum was observed favourable for arbuscular mycorrhizal fungal colonization.

Seasonal host colonization patterns were highly correlated with available phosphorus, soil moisture content and source-sink relationships linked to the plants growth stages, light, temperature, pH and organic carbon.

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