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AN ASSESSMENT OF VEGETATION DOMINANCE AGAINST MOISTURE STRESS IN CHANGA MANGA FOREST

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Abstract

Multivariate technique i.e., CCA has been used to analyze the response of the species against the stress due to moisture. GLM (General Linear Model) response curve and attribute plot using 3-D contour has been used to see the response of the different species in each zone of the Changa Manga forest. Response curve shows that *Cynodon dactylon* was dominant in two zones i.e., zone-I and zone-III of the forest against moisture stress. *Desmostachya bipinnata* was dominant in zone-II where as *Conyza canadensis* was dominant in zone-IV. As *Cynodon dactylon* was the mostly dominant specie in the park the difference in the dominance has been seen in the two zone of park which has been justified by using data attribute plot.

Introduction

Stress is continuously experienced in the biosphere, which includes drought, salinity, extreme temperatures etc. These stresses cause instability in the natural ecosystem (Lisar *et al*., 2012). Stress in usually taken as a reaction of the biological system against the extreme environmental aspects depends on the interval and strength of that change, causing momentous change in the system (Göring, 1982; Nilsen & Orcutt, 1996; Godbold, 1998).

Progress has been made since recent years in the identification of the genetic mechanism which makes the plants capable to survive against the abiotic stresses (Zhang *et al.,* 2006). The plants which are well adapted to these sorts of environment survive (Yordanov *et al*., 2003). The stress in the environment can have the positive and negative and it is one of the selection factor for the best suitable plant species at that particular stress or environmental factor. This also improves the resistance and adaptive evolution (Larcher, 1987).

A multivariate technique, CCA was used for analyzing the floristic composition. Sixty six quadrats resulted in the identification of 35 herbaceous plant species. The conducted study helped in demarcation of the vegetation and its response to selected environmental factors. Soil moisture was the most important factor manipulating the herbaceous vegetation response of the specie which was depicted by the Linear model response curve. It was justified that *Cymbopogon jwarancusa* demonstrated less stress against soil moisture. Species showed diverse response with respect to maximum stress. This indicated that species assemblage is influenced by soil moisture. This study helps in the preservation and improving the roadside vegetation (Ahmad & Ehsan, 2012).

Response curve is a graphical representation in CCA which exhibits the magnitude of the response given against any stimulus. Determination of species response on the basis of certain gradient which is under study is one of the most important tasks of the ecology. Response curve make it possible to estimate the species optimum, tolerance, identifies the specialist and generalists species. Statistical methods has been assumed widely that the species response on gradient have symmetrical bell shape of Gaussian curve. Bell shaped curve is mainly a reference showing what a response will look like in Gaussian model (Austin, 2002). GLM is widely used model which usually support linear model, where counts, relative frequencies, probabilities and physical dimensions are represented by the response variables. It is assumption of classical linear regression. Such distributions are supported by standard distributions. (Poisson, Binomial, Gamma, Gaussian) and it supports the canonical link function. Specification of the effect of predictors is done into purely linear or as second or third degree polynomial (John & Robert, 1972).

Correspondence analysis is added to the methodology of statistical including regression thus leads to the provision of a general framework for the estimation and statistical testing of the environmental variables and other explanatory variables on biological communities effects , even if these effects gets hidden by other large sources of changes. For brief description and visualization of different habitat preferences, the gradients in CCA are used and they represent it from ordination diagram (Braak & Verdonschot, 1995). Thus canonical correspondence analysis is a technique which helps the ecologists disentangling that how a mass of species respond to external factors. Canonical correspondence analysis (CCA) and associated tactics has found that it has extensive use in aquatic sciences. Mainly the most common use is identification of gradients of environment in data-sets of ecology (Barker, 1994), e.g., ascertaining such environmental variables which shows importance in the determination of the composition of the community, as shown by Jones *et al*., (1993). CCA is often used as a prelude analysis in palaeolimnology for deciding whether present day communities are influenced by particular variables sufficiently to justify paleo-reconstruction using fossil fuel assemblage (Walker *et al*., 1991; Cumming *et al*., 1992; Anderson *et al*., 1992; Fritz, *et al*., 1993; Charles & Smol, 1994).

Identification of the groups of species relationship in relative to the factors of environment was conducted in Lohi Bher Wildlife Park. The relationship between overall community assemblage and species diversity was identified in 2 different zones in that area. Correlation of environmental variables with species abundance/richness was determined by using Canonical Correspondence Analysis (CCA). The obtained results showed that species were scattered in Zone 1 due to less accessibility and availability of the soil moisture and organic matter as they occupy the less dense forest cover. Whereas opposite trend was seen in Zone 2. Comparing the both zones maximum number of quadrats included species of zone 2 because of the large forest cover, with excess amount of soil moisture and organic matter. Dynamic nature and vegetation composition has been highlighted by this study and importance on conservation on native flora was laid (Ahmad & Qurat ul Ann, 2011).

The main objective of the study was to assess the species domination against the moisture stress.

Materials and Methods

Vegetation data of Changa Manga forest was taken randomly by using quadrats. Each quadrat was estimated consisting of herbaceous plants using Domin cover scale (Kent & Coker, 1995). For extensive study of the Changa Manga forest the area was demarcated into four zones. 31 quadrats were taken in Zone-I. 33 quadrats were laid in Zone-II, where as 79 quadrats were present in Zone-III, while 55 quadrats were undertaken in Zone-IV. The data collection was done during spring. Multivariate analysis was carried out using CANOCO 4.5 software.

Results

Generalized linear model curve has been drawn for the species in the CMF against the environmental variable i.e soil moisture. A total of 45 species belonging to 24 families has been identified using 200 quadrats. The whole area was divided into four particular zones.

Zone-1: In Zone-I *Cynodon dactylon* was at the top of the all species in the response curve against the soil moisture variable. It was the most abundant specie as it had upper quartile 76 and lower quartile 40 while median was 55. *Parthenium hysterophorus* held the second highest position. It had upper quartile 50 and lower quartile of 7 and its median was 27. The lowest most specie was *Desmostachya bipinnata* with upper and lower quartile with 0 value and median with 0 value. The other species came under the stress and did not respond well to the soil moisture variable (Fig. 1).

Zone-II: Zone-II, the top most abundant specie was *Desmostachya bipinnata.* It showed its upper quartile at 60 and lower at 8 with the median of 40. *Parthenium hysterophorus* in response to the moisture came in the second most abundant position in the linear response curve, which had upper quartile 50 and lower quartile 11 and the median value at 24. The lowest most specie was *Cynodon dactylon* which had upper and lower quartile at 0 along with the median at 0 (Fig. 2).

Zone-III: The most abundant specie in Zone-III was *Cynodon* dactylon (Fig. 3). It had the upper quartile as 45 while lower quartile was 4 with the median of 30. The second most abundant species according to the upper and lower quartile was *Cirsium arvense.* The upper quartile was 15 while lower quartile and median was zero.

Zone-IV: All the species were seen under the stress. *Conyza canadensis* was one showing some of the response towards moisture and fighting against the moisture stress. It had lower quartile and median zero, upper quartile was 10. *Zizipus numularia* also seemed to be working against the stress. It had upper, lower quartile and median zero (Fig. 4).

Discussion

The relationship between plants and soil are very close and vegetation cover and its component species are reasonably good indicator of soil conditions. Soil provides a foremost reservoir for the collection of water within (Mahmood *et al*., 1994).

CCA technique using ordination describes the relation of the group of species with the environmental variables (Kashian *et al.*, 2003; Ahmad, 2011). Generalized linear model curve has been drawn for the species in the CMF against the environmental variable i.e., soil moisture. The response of those species was shown against the moisture stresses which were dominant in the CMF. In CMF the plant species especially *Cirsium arvense* was usually found in such areas where water was nearby. Like near the lakes and dry scape. Most of the species were seen under stress in Zone-IV because of the high number of the species, competition and prone to the over grazing and over cutting as these activities were widely observed in Zone-IV. *Conyza canadensis* although showed some of the tolerance against the stress in the moisture. The dominancy of the *Cynodon dactylon, Desmostachya bipinnata, Parthenium hysterophorus* in the forest showed that this area would be of moderate moisture or low moisture as they could survive and tolerate the stress and could grow in every kind of the moisture. *Parthenium hysterophorus* can compete with the other species for its survival. It is known by its environmental impacts because of its invasive capacity and allelopathic properties.

Data attribute plot was used to witness the Specie’s joint correlation (either strong or weak) with respect to environmental gradients i.e. soil moisture, organic matter, phosphorous, potassium and pH. For the clear understanding, that how the separate specie respond to multiple variables with respect to its distribution, two 3-D contour attribute plots (using Loess model) were drawn. Because unlike generalized linear models, this attribute plot can show joint effect of explanatory predictors (environment variables) by fitting smoothly used data points (species) and their weight (distribution) across the ordination space.

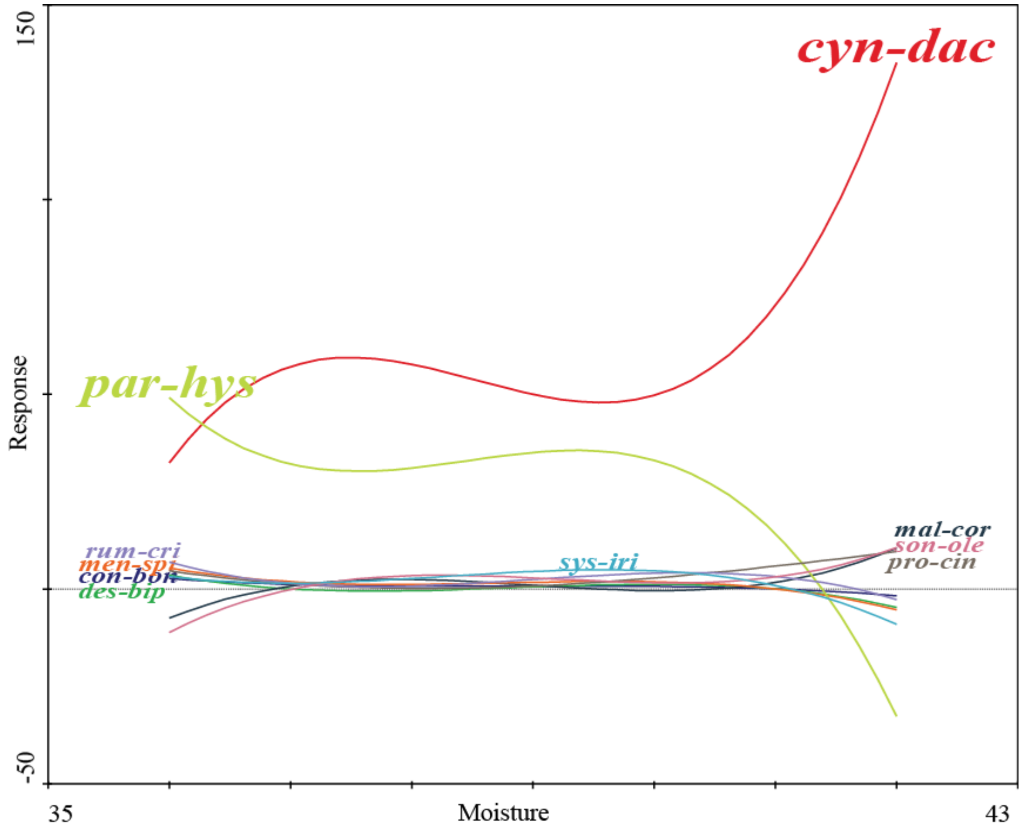

Fig. 1. Response curve of Zone-I.

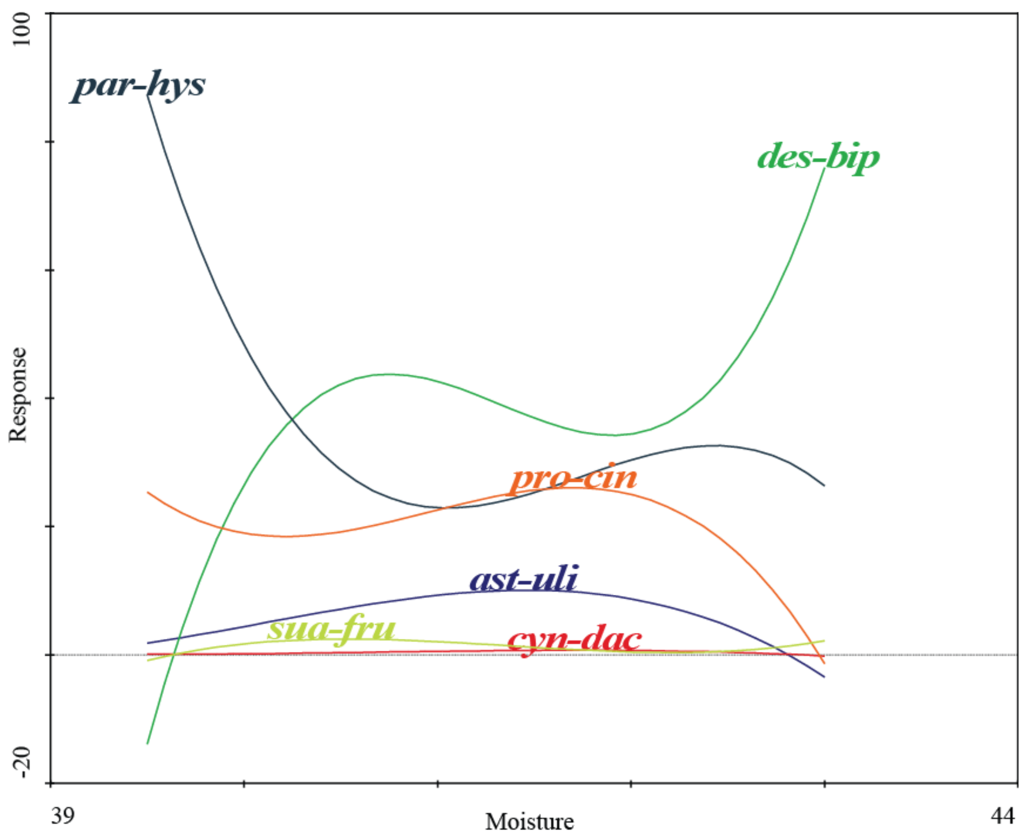

Fig. 2. Response curve of Zone-II.

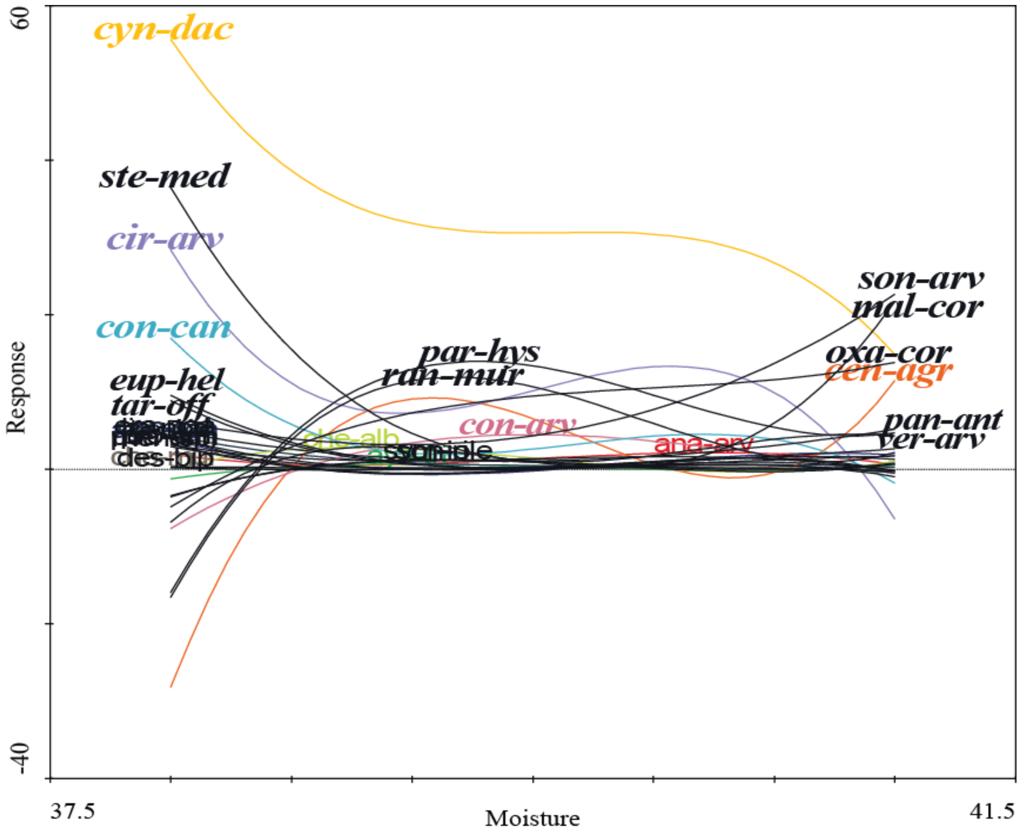

Fig. 3. Response curve of Zone-III.

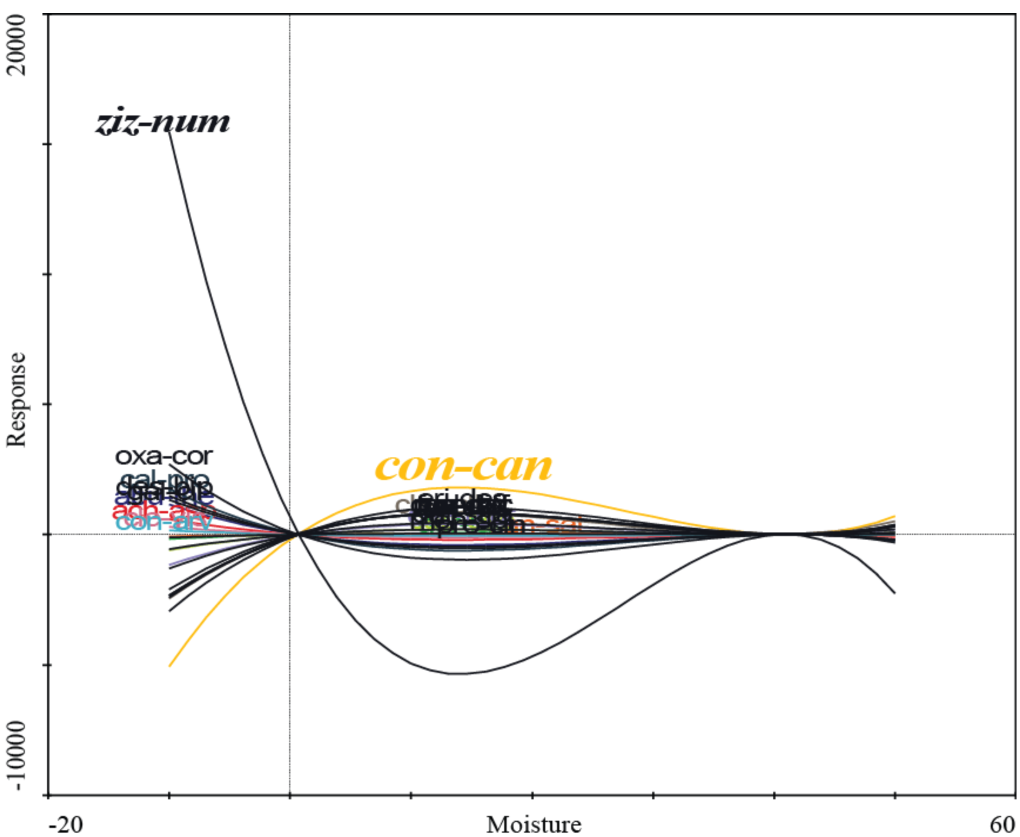

Fig. 4. Response curve of Zone-IV.

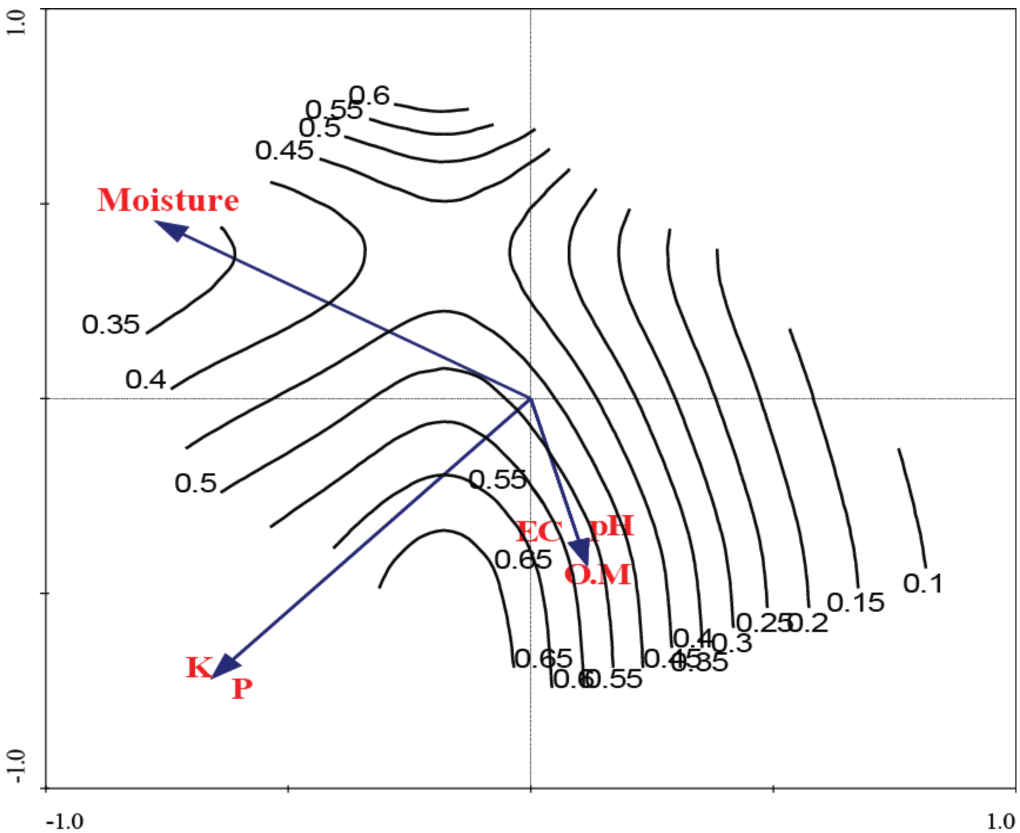

Fig. 5. Data attribute plot Zone-II.

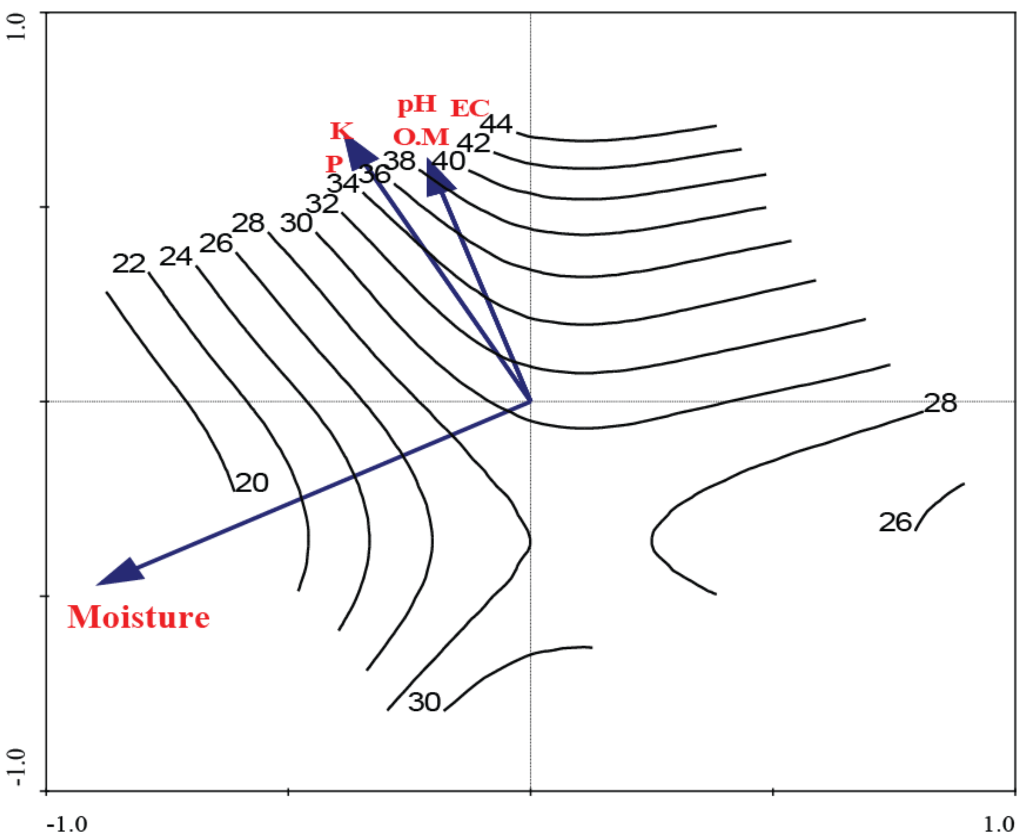

Fig. 6. Data attribute plot Zone-III.

The correlation of *Cynodon dactylon* with the environment variables in Zone-II and Zone-III (Figs. 5 & 6), show only the loess fitted area. Each arrow points in the predictable direction of the steepest increase of values of environmental gradient and angles between arrows indicate correlations among individual environmental gradient. The attribute plot (GAM) was referred, which also justified the GLM and indicating *Cynodon dactylon* as the dominant specie in that zone combating the stress due to moisture availability in the Changa Manga Forest. Strong correlation of the 3-D contour had been seen because the contour lines passing underneath the arrow of the moisture variable showed immanency among themselves as compared to the Zone-II.

Weak correlation was observed between *Cynodon dactylon* and environment variables with respect to distribution (Fig. 5). In this graph it was clear that the lines representing the moisture variable had gaps in between them while the theoretical range of data was very low. And it has been shown in the GLM of Zone-II that *Cynodon dactylon* was under stress.

The results obtained from the GLM were easy to interpret and it allows the clear analysis and makes it understandable that how the predictors influencing the prediction. It describes the patterns of association and interaction in the obtained data.

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