INTRODUCTION

The term phenology is derived from the Greek word "Phaino" meaning "to show" or "to appear" (Rathcke and Lacey, 1985). Hence phenology is defined as "The study of seasonal timing of life cycle events."

The phenological pattern of any life cycle event can be quantitatively defined as a statistical distribution characterized by such parameters as time of occurrence (onset, mean, mode), duration (range), synchrony (variance) and skewness.

Phenology is an important function of forest ecosystem that relates the growth habit of a species with the physical environment. The periodic developments in plants at a place are largely determined by their changing environment. Phenology embraces all the studies of the relationships between environmental factors and periodic developmental phenomenon in plant. Each stage in periodic phenomenon is termed as phenophase and the sequence of different phenophases in a year is called phenodynamic analysis. It is a quantitative measurement of life cycle or specific phenophase. The main phenophases in plants are viz., seed
germination, bud bursting, leaf development, flowering time, fruit and seed dispersal, senescence and litter fall (Leith, 1970)

Phenology is generally describes as the art of observing the phase of life cycle of the activities of organisms as they occur through the year (Leith, 1973). The phenological events are meaningful in describing and explaining seasonal aspect of ecological phenomenon and help in felling series, utilisation of bioproduct and management of the species. There are many aspects of productivity, which can be categorised, predicted and evaluated on the basis of phenological attributes.

Phenology permits a calendar to construct for the growth activity of plants especially the periods of initiation of new leaf bud, appearance of mature leaves, flower bud initiation, formation of mature flowers, young fruit formation and seed maturity etc. These informations are prerequisite for studies on the reproductive biology, breeding systems and silvicultural practices of a species (Khosla; Reddy and Sehgal, 1990)

Amenity plantation is an urgent need of modern era of rapid industrialization and urbanisation. It is needed to satiate the increased concern about environmental conservation. However, it is very difficult to plan amenity plantation without the knowledge of phenological calendar of selected species. The need to evaluate phenological data on forest species has been felt long in the field of botany and forestry.
Inquiries into the phenology of tropical plants mostly take one or two approaches. The first is to examine the intrapopulational behaviour of single species or less commonly group to related species in relation to environmental factor (Ashton, Givnish and Appanah, 1988). The studies focus on proximate physiological releasing mechanisms.

The second approach is to document the phenology of plant gudids or communities in the interest of revealing broad, community-wide patterns of leafing, flowering or fruiting (Koelmeyer, 1959 a&b; Frankie, Baker and Opler, 1974; Croat, 1975 and Sabatier, 1985). These studies are often used to generate indices to the food supply available to animal consumers. They only rarely address physiological mechanisms, but can offer insights into the ultimate evolutionary causes that may have selected for particular pattern of phenology.

The phenological observations have been made in floristic, ecological and meteorological investigation. It is closely linked with the forestry regeneration programme. The phenological studies are useful in determining the character of forest floor sampling plants for the litter layer of forest (Bhatnagar, 1968).

Review Of Literature

The term 'phenology' was first used by Shelford(1929) to correlate the appearance of certain events. The stages in the life cycle of 37
weedy angiosperms have been studies in relation to various seasons and months of a year (Ansari and Ghananand, 1987)

Impact of grazing on phenology and life-form spectrum of vegetation has been studied (Gupta & Singh, 1990). Grazing has been found to effect phenology and floristic composition (Misra, 1970, Sims et al; 1976), and Shankarnarayan, 1977). However, Dickinson and Dodd,(1976) has reported that grazing has no effect on phenology of plants.

Some workers emphasize that the climatic conditions effect phenological events to a certain extent. Blatter, (1906) found correlation of flowering period with climate. Ahlgren, (1957) observed an obvious relationship between flowering and leafing responses of temperate forest of Minnesto. Nanda, (1962) has shown the importance of light in flowering of Teak. Khan, (1970) recorded the phenological observations of Acacia nilotica and found that the phenomenon is mainly governed by rainfall, temperature and evaporation. Rainfall primarily influences leafing, whereas, temperature effects flowering and fruiting. Flowering is effected both by relative humidity and evaporation.

Various other workers have also studied the phenological events of different plant species. some of them are viz; Holmes, 1942; Sagreiya, 1942; Krishnaswamy and Mathauda. 1954 ;Ganapathy and Rangarajan, 1964; Kaul and Yutshi, 1966; Daubenmire,1972; Medway, 1972 Kaul and Raina. 1980; Khosla,Shamet and Sehgal.

Materials And Method

The study was conducted in Chandpura forest situated on the bank of river Betwa. The soil of the study site was sandy-red and of low quality. The site was visited fortnightly from May 1993 to May 1994. Different stages of phenophase and their sequences were recorded in every visit after keenly observing fifty random individuals of Vitex negundo. Thus twelve month calendar of phenological events was prepared. Phenograms fig (3.1) were drawn according to Harper (1906). Various phenophases studied were:

(1) Budding,
(2) Vegetative
(3) Flowering
(4) Fruiting,
(5) seed maturation, and
(6) Dispersed phase.

Results And Discussion

In the present study phenological calendar of V. negundo range between May 93 to May 94. The sequence of different phenophases of V. negundo is depicted in fig (3.2). The phenological calendar is exhibited in Table (3.1) Fig (3.3). The perusal of both the figures indicate that the fruiting and seed maturation phases of this
Figure 3.1 Phenograms as per Harper (1906)
SYMBOL PHENOLOGICAL PHASES:

B = Budding phase;  V = Vegetative phase;
Fl = Flowering phase;  Fr = Fruting phase;
S = Seed maturity phase;  D = Dispersal phase.

Figure 3.2 Phenodynamic analysis of *Vitex negundo* Linn.
Table 3.1: - Phenological calendar of *Vitex negundo* Linn.

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Legends:  
B = Budding phase  
V = Vegetative phase  
F = Flowering phase  
Fr = Fruiting phase  
S = Seed maturation phase  
D = Dispersal phase  
+ = Present  
- = Absent
Figure 3.3 Phenological calendar of *Vitex negundo* Linn.
medicinal and aromatic shrub were totally absent during May, June and July. However, the phase of flowering occurred with varying intensities throughout the year (Bhatt and Saxena, 1995). The fruiting and seed maturation phases were observed between August to April. The peak of these phases were recorded in the month of November, whereas the lowest values were noted in the month of April. Both these phases were initiated during mid of rainy season and came to an end at the onset of summer months.

The phases of seed dispersion was recorded between January to May and in the month of October. Budding and vegetative phases were spread over the entire period of study.

The seed also start germination in the mid June and it continue till September as the germinating seed require optimum moisture and temperature (Tothill, 1977). The rainy season provided all the requirements. During winter and summer the germination was completely absent.

The flowering pattern was a synchronous i.e buds and flowers were at different stages of development even on the same tree. Accordingly the species had adapted for insect pollination rather than birds or other animals. The flowering pattern, showing a low rate in the month of February and March, gradually increases to peak and then decline in the same order, seems to support the level of out crossing by eliminating the effect of competition for the pollinator.
Phenological study revealed that diversity was very much affected by the climatic condition and moisture. Diversity was high in rainy season due to the growth of producer, more over maximum number of seed germinate during rainy season. In nature during rainy season the seeds subjected to alternate soaking and drying periods. This increase the seed coat permeability and thus induces germination.

Flowering in *V. negundo* normally happens throughout the year in varying intensities, but it happens to be highest in the month of November and lowest during February - March. It can be concluded that the flowering in *V. negundo* is related directly to the temperature.

It is seen that fruiting and seed formation does not place between May to July, which illustrate that high temperature and low relative humidity decreases fruiting and seed formation. The leaf fall increases with decrease in the atmospheric temperature. It is highest in the month of January.