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Seasonality of emergence of selected annual weeds in coconut garden

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ABSTRACT

A long-term trial was conducted in the coconut plantation at Thrissur, Kerala, India from July 2008 to June 2013. Time series analysis was performed with monthly weed count data to determine seasonality of selected weeds of a coconut garden. A multiplicative model was assumed for the time series and the seasonal index was worked out for each weed species. The results revealed that *Axonopus compressus*, *Biophytum sensitivum* and *Mimosa pudica* dominated during the South West monsoon season while *Curculigo orchioides* and *Desmodium gangeticum* were seen germinating during the North East monsoon period from September– October and were predominant in the field till February. *Hemidesmus indicus* and *M. pudica* were the weed species seen throughout the year. However, their predominance was the field was between November to April and July to November, respectively.

Keywords: Seasonal index, Weed emergence pattern, Soil seed bank, Coconut plantation

Accumulation of weed seeds helps in the buildup of a population in the soil seed bank. Germination of these seeds in portions over a number of years accounts for the persistence of annual weeds in the ecosystem. Weed seeds exhibit distinct seasonal variation in germination which is determined by both intrinsic factors like dormancy and extrinsic factors like moisture content of soil, temperature, light etc. Soil temperature and soil water availability are regulated by weather (Frank 2003)**.** Seeds buried in soil and exposed to natural temperature cycles exhibit seasonal variation in germination. Akobundu (1987) has reported that weed seeds showed periodicity of germination more in response to variation in temperature and soil moisture content than the tillage practices adopted. Information on the seasonality of germination of weed seeds will help to make predictions on their incidence in the succeeding years. Catherine *et al.* (2010) have used a time series estimation of 66 weed species of the Pacific Northwest and northern Rocky Mountain counties to forecast the weed distribution data. However, timing weed seed emergence is a critical factor for the weed and is equally important for the weed managers. The study was undertaken to understand the seasonality of germination of weed seeds from the soil seed bank of a coconut plantation. Data were collected from a long-term trial started in the coconut plantation at the College of Horticulture, Vellanikkara, Thrissur in July 2008. Time series analysis (Anderson 2011) was performed with monthly weed counts registered from July 2008 to June 2013 to determine seasonality of selected weeds of the coconut garden.

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MATERIALS AND METHODS

The germinating weed seedlings were uprooted and counted species-wise at 15 days interval from 5 peg marked regions of 0.25 m^2 area in the field. The observations were taken for five years from July 2008 to June 2013; data were then converted to monthly weed counts. To understand the influence of season on weed emergence, a time series analysis of the data was done with the weed counts taken for 60 months from July 2008 to June 2013. A multiplicative model was assumed for the time series as given by (Johnson *et al.* 1990)

$$Y = T \times S \times C \times I$$

Where, *Y*- weed count in a month, *T*- trend, *S*- seasonal variation, *C*- cyclic variation and *I*- irregular variation.

Seasonality in weeds for each species was estimated as seasonal indices by the method of moving averages as given by Croxton *et al.* 1979. From the monthly weed count data from July 2008 to June 2013, 12 month moving averages were computed. This involves the computation of the arithmetic mean of the weed count of a species from July 2008 to June 2009, August 2008 to July 2009 and so on. These moving averages represent the combined effects of trend (*T*) and cyclic variation (*C*). The original weed count (*Y*) for each species was

then expressed as percentage of the moving averages. These percentages include the seasonal and irregular variations.

$$\frac{\text{Seasonal variation (S)}}{\text{Irregular variation (I)}} = \frac{\text{Original weed count (Y)}}{\text{Trend (T) x Cyclic Variation(C)}} \text{ X } 100$$

Irregular variations were then eliminated by averaging the above percentages over the years 2008 to 2013, giving the seasonal variations. The seasonal variations thus obtained were converted to fractions to get the seasonal indices from January to December. Seasonal index expresses the seasonality of occurrence of a weed. The analysis was done using SPSS 17.

RESULTS AND DISCUSSION

During the beginning of the trial, 37 weed species were observed in the field. The species and their density varied with each sampling. This may be due to physiological factors like dormancy, depth at which the propagules are located, environmental conditions *etc*. However, every year maximum species diversity was observed in the field with the beginning of the South West monsoon which starts by early June. Nearly 25 weed species were found to germinate in the field during this period. After 60 months of study and 120 samplings the species which continued to germinate from the soil seed bank were *Hemidesmus indicus, Chromolaena odorata, Borreria latifolia, Phyllanthus niruri, Euphorbia hirta, Synedrella nodiflora, Mitracarpus villosus, Cyperus iria, Sida cordata, Pouzolzia zeylanica, Scoparia dulcis, Triumfetta indica, Axonopus compressus, Biophytum sensitivum, Elephantopus scaber, Ruellia prostrata, Commelina benghalensis, Stachytarpheta indica, Ischaemum indicum, Centrosema pubscens, Brachairia miliformis, Mimosa pudica, Curculigo orchioides* and *Desmodium gangeticum.*

The weed species that were most predominant in most of the sampling units and exhibited seasonality in its occurrence as per the data collected were selected for estimation of seasonal indices. The selected weed species for which seasonal indices were worked out are given in Table 1. A seasonal index value of more than one indicates the predominance of the weed in the particular month. Any value below one indicates low incidence of the weed. A zero value indicates complete absence of the species during the period.

Seasonality exhibited in the germination of weed species is given in Table 1. The presence of the weeds in the field may extend to a further period of two to three months depending on the duration of the species. *H. indicus* is a predominant summer weed. The weeds *S. nodiflora, B. latifolia, A. compressus and B. sensitivum* appear with the first showers in May. The pattern of weed seed germination from the soil seed bank is represented graphically (Fig. 1(a)).

H. indicus is a weed found to germinate throughout the year. The peak germination period of this weed is from November to March, since most of the other weed species do not germinate during this season, it is a predominant weed in upland ecosystem during summer. Both *Sida acuta* and *Synedrella nodiflora* are weeds which start germination from April - May with the receipt of summer showers in the state and continue up to November - December. However, the germination of *Sida acuta* is higher during the period from June- July to September - October. The germination peak of *Synedrella nodiflora* is during August- September and continues

Table 1. Seasonal indices of major weeds of coconut garden

Month	*H. indicus*	*S. acuta*	*S. nodiflora*	*B. latifolia*	*C. orchioides*	*A. compressus*	*B. sensitivum*	*M. pudica*	*D. gangeticum*
January	1.12	0.15	0.00	0.03	0.06	0.00	0.02	0.35	0.04
February	1.70	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00
March	1.70	0.00	0.00	0.00	0.00	0.00	0.12	0.07	0.48
April	1.25	0.24	0.00	0.37	0.51	0.00	0.37	0.32	0.35
May	0.38	0.25	1.87	1.98	0.93	2.50	1.13	0.26	1.36
June	0.32	0.98	1.23	1.39	1.03	3.17	0.94	0.67	6.10
July	0.99	3.04	2.51	3.94	4.84	3.60	2.65	1.55	2.17
August	0.74	2.50	2.76	0.75	1.41	1.49	2.88	1.96	0.73
September	0.40	1.36	1.72	0.87	0.71	0.81	1.38	2.58	0.37
October	0.53	2.58	1.24	0.96	1.22	0.21	1.48	2.11	0.00
November	1.37	0.72	0.67	1.62	1.20	0.21	0.76	1.82	0.39
December	1.48	0.17	0.00	0.09	0.08	0.00	0.26	0.17	0.00

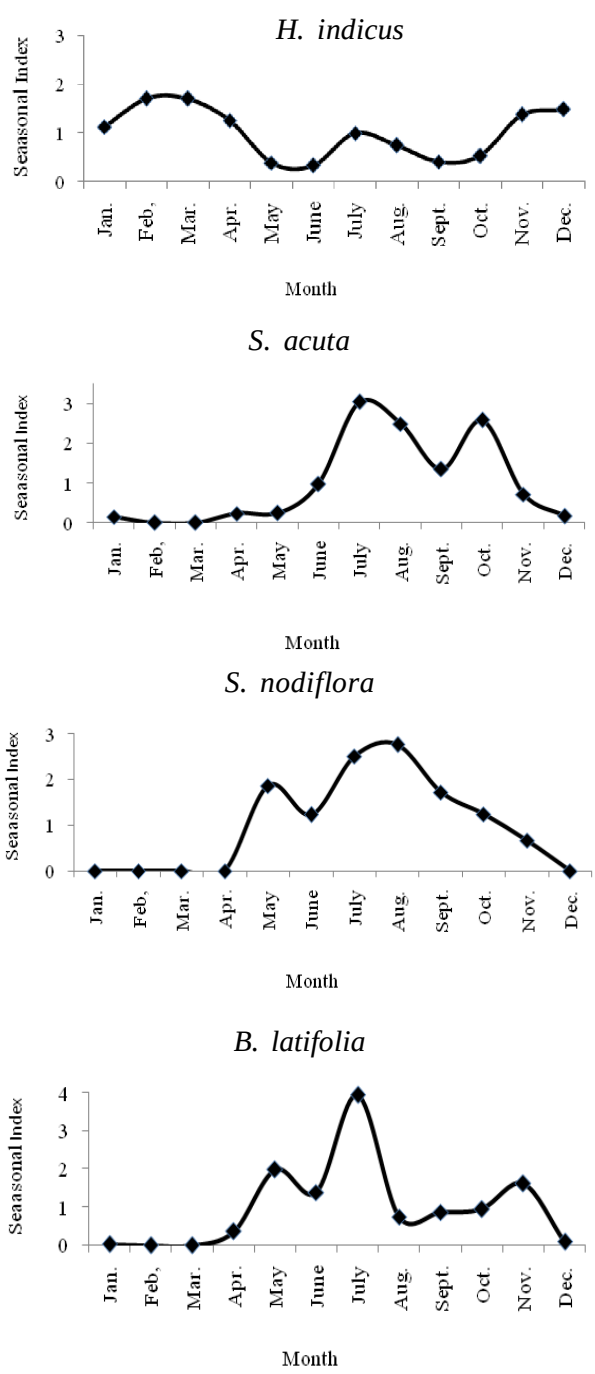

Fig. 1(a). Monthly pattern of emergence of *H. indicus, S. acuta, S. nodiflora* and *B. latifolia*

till November-December. It is one of the main weed species observed during the period from December to February in the state. The seasonality of germination of *Borreria latifolia* revealed that they germinate with the receipt of summer showers in March - April and reaches a peak by the advancement of the South - West monsoon season which starts from May - June in the state. By August, the population declines and a second flush of the weed are seen in September-October with the arrival of the North East monsoon.

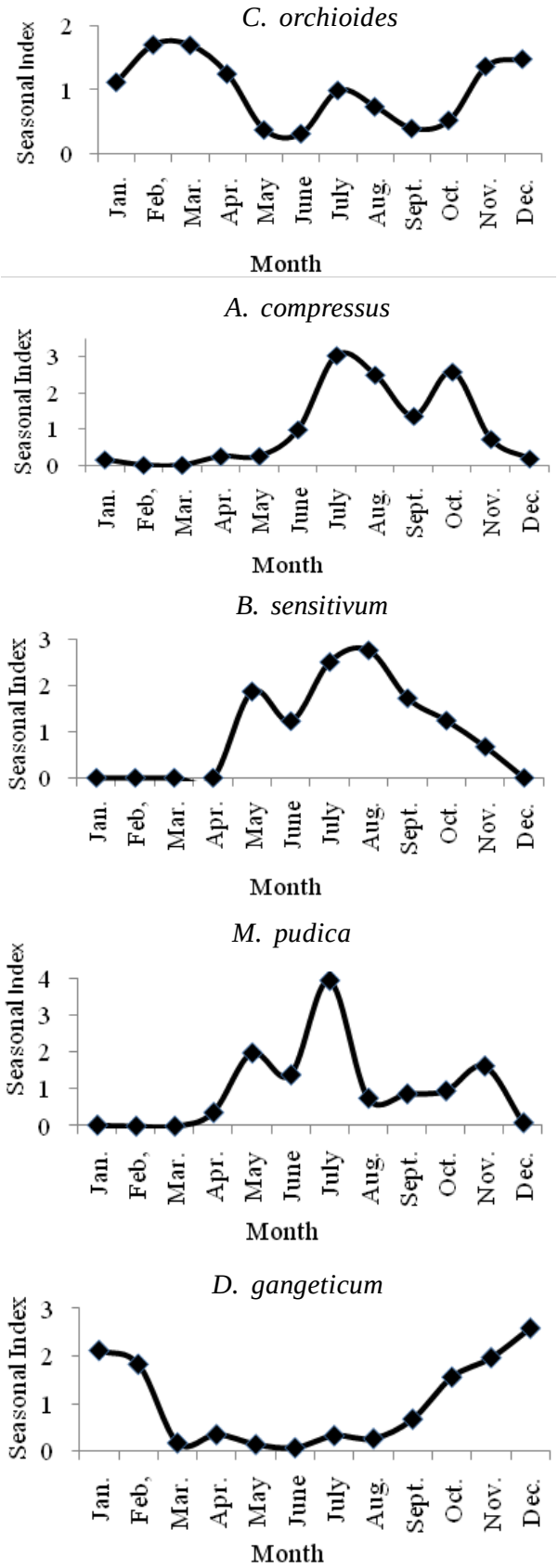

Fig. 1(b). Monthly pattern of emergence of *C. orchioides, A. compressus, B. sensitivum, M. pudica* and *D. gangeticum*

The germination of the weed continues till December after which there is a lull in its germination. However, the weed is observed in the field till February-March. The prevalence of the weed from October to January in Mangalore on sand dunes has been reported by Beena *et al.* 2001. Mangalore has a similar rainfall pattern and climate as Kerala.

The emergence of *C. orchioides* indicates that the weed germinates throughout the year with a lull during the peak summer months of March- April when the moisture availability in the soil is minimum. Though, the weed is seed propagated, the presence of underground tuber may encourage regrowth of shoot with moisture availability. *A. compressus* is a grass weed which germinates with the onset of the South West monsoon in June - July and continues till November with a second peak during the North East monsoon in September - October. The weed is rarely seen during summer. *B. sensitivum* starts germination with the receipt of the first rains in April - May and germinates throughout the rainy season in the state from June - July to October - November, and for the rest of period from December to March - April the weed is rarely seen in the field. *M. pudica* is similar to *B. sensitivum* in its germination pattern but the germinated plants remain in the field for longer time and are prevalent till February - March. However, during peak summer months of March - April the weed is seen only in irrigated situations. Flowering commences about 3 months after germination, and can occur throughout the year in tropical countries (Challa *et al.* 1991). *D. gangeticum* has a prostrate nature and it forms a cover on the soil. It starts germination only by September - October and continues to germinate throughout the summer months till March with minimum moisture availability in the soil.

The pattern of germination of the weeds from the soil seed bank indicated that *Axonopus*, *Biophytum* and *M. pudica* dominated during the South West monsoon season while *C. orchioides* and *D. gangeticum* were seen to germinate during the North East Monsoon period from September – October and are present in the field till the advent of summer season in the state. *H. indicus* and *M. pudica* are weed species seen throughout the year. However, their predominance in the field is between November to April and July to November, respectively (Fig. 1(b)).

Information on the emergence pattern of a weed species in an ecosystem is necessary for devising weed control operations for specific weed flora. Variable weed emergence patterns have many consequences for site-specific weed management. Understanding the causes of differential weed emergence permits more informed decisions, more timely operations, and better management. Seasonal index is a useful parameter to predict the seasonality of weed emergence.

REFERENCES

Akobundu IO. 1987. *Weed science in tropics: Principles and practices.* Publishing Co. John Wiley and Sons. USA,- 522 p.

Anderson TW. 2011. *The Statistical Analysis of Time Series.* Published Online: *http:// online library.wiley.com/book.*

Beena KR, Raviraja NS, Arun AB and Sridhar KR. 2000. Diversity of arbuscular mycorrhizal fungi on the coastal sand dunes of west coast of India. *Current Science* **79**:1459-1466.

Catherine JS, Holcombe TR, Barnett DT, Stohlgren TJ, and Kartesz JT. 2010. Forecasting weed distributions using climate data: A GIS Early Warning Tool. *Invasive Plant Science and Management* **3**(4): 365-375.

Challa P, Prakash J, Pierik RLM, 1991. Chemical weeding as a labour saving device in management of fruit nurseries, and. pp. 69-72. In: *Horticulture -New Technologies and Applications.*

Croxton F, Cowden DJ and Klein S. 1979. *Applied general statistics.* Publishing Co. Prentice Hall of India,New Delhi, India, 754 p.

Frank F. 2003. USDA Agricultural Research service research on pest biology: weeds. *Pest Management Science* **59**:754-763 (online 2003)

Johnson LA, Montgomery DC and Gardiner JS. 1990. *Forecasting and Time Series Analysis.* 2nd ed., Publishing Co. McGraw-Hill, Inc.