J. Phytol. Res. **31**(1 & 2) :49-54, 2018 **ISSN 0970-5767**

POPULATION DYNAMICS OF DESMODIUM REPANDUM (VAHL) DC.AND D. GANGETICUM (L.) DC. IN A TROPICAL DRY DECIDUOUS FOREST OF ALWAR RAJASTHAN

RAJENDRA PRASAD and A S YADAV*

Department of Botany, R R Autonomous College, Alwar -301001, Rajasthan
*Corresponding author: E-mail: atarsingh_1010@rediffmail.com

The population dynamics of *Desmodium repandum* and *Desmodium gangeticum* was studied over a two-year period in a tropical dry deciduous forest of Alwar in Rajasthan state (27° 4′ to 28° 4′ N and 76° 7′ to 77° 13′ E). The population density of *Desmodium repandum* (11.6 m^2) was higher than that of *Desmodium gangeticum* (2.8 m^2). However, the later species showed higher population growth rate (1.57) than the former (1.19). The seedling cohorts of *Desmodium repandum* showed Deevey Type II survivorship curve while that of *Desmodium gangeticum* showed Deevey Type I survivorship curve. The seedlings of both species suffered mortality mainly dry conditions and also due to competition with associated vegetation. The adult population of the perennial herb *Desmodium gangeticum* showed decrease in mortality with increase in age of individuals. It may be concluded that both the *Desmodium*species have stable population in this undisturbed forest.

Key words: Age structure, *Desmodium repandum, Desmodium gangeticum*, Mortality, Survivorship.

Introduction

Biodiversity is the most important natural resource for the survival of living organisms including humans. The global demand for medicinal plants has increased as a potential source of new bioactive molecules[1-3]. Ever increasing human interference with nature through unsustainable development threatens biodiversity which is a matter of global concern[4]. Thus, the conservation of plant species is of paramount importance for the welfare of the society. The problem is particularly serious in semi-arid regions where natural regeneration of plants is very slow due to limiting rainfall and extreme weather conditions. The Aravalli mountain ranges in Rajasthan support rich species diversity in the tropical dry deciduous forests. The unabated destruction of forest areas in the Aravalli ranges during the last century has restricted the distribution of rare indigenous species to small pockets of natural vegetation. Therefore, continuous documentation and the study of biology and population ecology of plant speciesare required for the proper management of these forests. The population dynamics of several species have been investigated[4-11].*Desmodium repandum* and *Desmodium gangeticum* have been used in traditional rainy season may be attributed to dry periods.

medicine for the treatment of various human ailments. *Desmodium repandum*is an annual herb and Desmodium *gangeticum*a perennial herb which grow in the tropical dry deciduous forests in Rajasthan. Both the species have low population density and limited distribution in forest areas of Alwar district in Rajasthan. The regulation of the number of individuals of both species in nature has not been studied so far in the semi-arid region of Rajasthan. It is, therefore, imperative to study their population growth rate and the mechanism of population regulation for their sustainable utilization. Hence, the demographic study of *Desmodium repandum* and *Desmodium gangeticum* was carried out over a two-year period in the tropical dry deciduous forest of Alwar in Rajasthan.

Material and Methods

The demographic study of *Desmodium repandum,*and *Desmodium gangeticum*was carried out in two study sites selected on the basis of their occurrence in nature in this region. The Bala-fort forest where *Desmodium repandum* grows profusely and the Sariska Tiger Reserve forest where *Desmodium gangeticum*shows normal growth. The climate of the region is hot and dry with three distinct seasons; summer season from March to June with maximum temperature 45 ^{0}C followed by rainy season from July to mid-September with annual average rainfall 600 mm and the winter season from October to February with minimum temperature as low as 4 ^{0}C and light showers of rain in December and January (Fig.1). In each study site where the population of a particular species exhibits normal growth, five permanent quadrats of 1 m^2 each were laid at random. Individuals of the species, that is, seedlings and established plants were tagged and mapped, and then their fate was followed at short and regular intervals. The population census was done at fortnightly intervals from July to December, at monthly intervals from January to June.

Cohorts of seedlings of all three species were marked in July 2010 and July 2011 when there was the highest recruitment in the permanent quadrats. Each seedling was tagged by tying a coloured thread at its base and the fate of each cohort was followed at regular intervals until June 2011 and June 2012, respectively in the study sites. A new seedling was treated as seedling for one year and if it survived more than one year, then it was designated as an established plant.

Results and Discussion

Population flux

The population density of Desmodium *repandum* was 11.6 plants m^{-2} where as it was 13.8 plants m^{-2} after two years study period (Table 1). However, being annual herb, the established plants exhibited 100 percent mortality with decrease in soil moisture at the end of growing season. *Desmodium gangeticum* population size was 2.8 plants m^{-2} in the beginning which increased to 4.4 plants m^{-2} at the end of the study period with a rate of increase 1.57 plants m^{-2} yr^{-1}. A comparative evaluation of the population flux of two species indicates that although the population size (stems m^{-2}) was higher in *Desmodium repandum* than that of *Desmodium gangeticum,* however, the population growth rate of the later was higher than that of the former which attributed to perennial habit of the later species. The older age groups showed higher survivorship (100%) in *Desmodium gangeticum.*

Survivorship

The seedlings cohorts of *Desmodium repandum* exhibited Deevey Type II curve with constant mortality rate

until the end of growing season when all the plants died due to senescence. The recruitment of seedlings was higher in the second year (2011) which may be due to increased seed production because of higher population density of adults during the first year (2010) (Fig. 2).

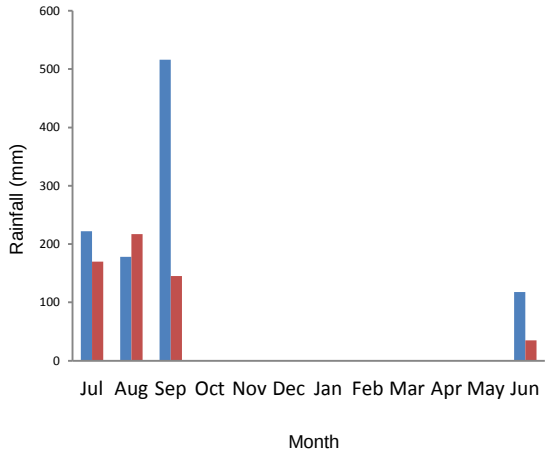

Fig. 1 Monthly rainfall during the study period (blue) 2010-11 and (red) - 2011-12 in a tropical drydeciduous forest in Alwar

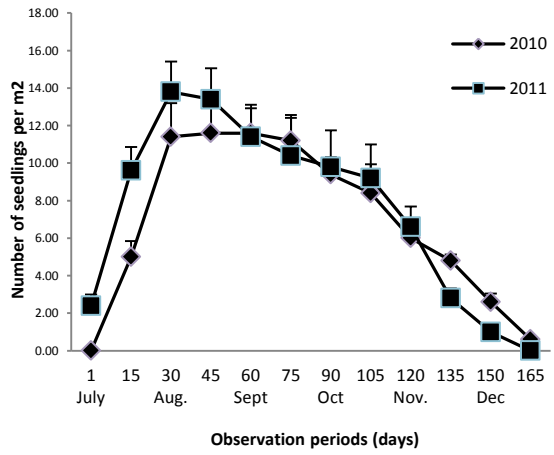

Fig.2: Survivorship of *Desmodium repandum* population in two year study periods (July,2010 to June,2012) in Alwar.

The seedling cohort of *Desmodium gangeticum* showed deevey type I survivorship curve with less mortality in early stage and increased mortality at the end of growing season from October onwards (Fig. 3,4). The seedling recruitment was almost equal to that of the first year. *Desmodium gangeticum* exhibited higher survivorship of established plants of older age groups.

	Parameter	*Desmodium repandum*	*Desmodium gangeticum*
a)	Number of plant present on 1.7.2010	11.6	2.8
b)	Number of plant present on 1.6.2012	13.8	4.4
c)	Net change (b-a)	2.2	1.6
d)	Rate of increase (b/a)	1.19	1.57
e)	Number of plants arrived between 1.7.2010 to 1.6.2012	25.4	22
f)	Total number of plants lost between 1.7.2010 to 1.6.2012	25.4	20.4
g)	Plants present on 1.7.2010 alive by 1.6.2012	0	2.8
h)	Percentage survival of plants present in (a), (g/a X 100)	0	100
i)	Total number of plants recorded during the study	25.4	24.8
j)	Percentage annual mortality of all individuals (f/i X 100)	100	82.25

Table 1:.Population flux of *Desmodium* species over a two year study period (1.7.2010 - 1.6.2012) in the tropical dry deciduous forest in Alwar.

Mortality

The mortality rate of established plants of *Desmodium repandum* exhibited a similar pattern over a two year period (Fig. 5). The mortality of plants commences at the end of September with the withdrawal of monsoon in this region. It increases gradually through October and then rapidly with senescence of all plants by the end of December. The seedling mortality may also be caused by grazing of herbivores as

reported for seedling population of *Indigofera trita*[12]. The seedling mortality in rainy season may be attributed to dry periods.

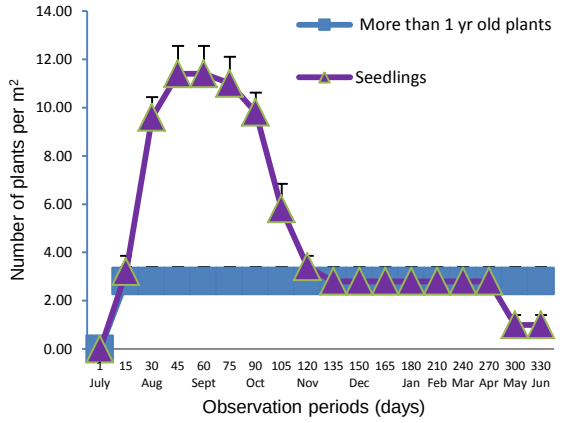

Fig. 3: Survivorship of *Desmodium gangeticum* population in first year (July,2010 to June, 2011) in the Forest in Alwar.

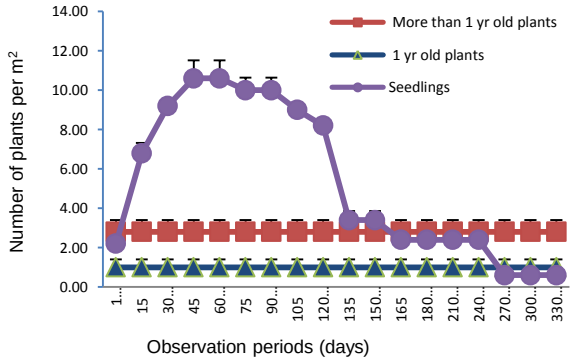

Fig.4:Survivorship of *Desmodium gangeticum* population in second year (July, 2011 to June, 2012) in the Forest in Alwar.

Yadav[13] reported high seedling mortality in *Holopteleaintegri folia* due to dry periods during rainy season and very low soil moisture content in winter and summer season in Alwar district. The seedling mortality due to drought has also been reported[13-14]. The closed tree canopy in forest during growing season may also cause seedling mortality[15]. Seedling mortality in other plant species under tree canopy has been observed[16, 17]. The mortality rate was higher in the first year (2010) than that in the second year (2011) which may be attributed to variation in the annual rainfall in Alwar. The established plants of *Desmodium gangeticum* exhibited 100 percent survivorship (Fig. 6 & 7). The seedling which survived until December exhibited almost negligible mortality. This indicates that established plants of this species do not die due to harsh climatic conditions and the death may be caused due to senescence or attack of herbivores or termites which are common in these forests.

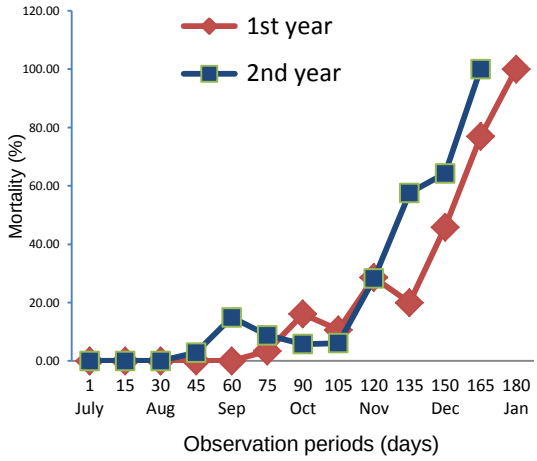

Fig.5: Periodic mortality of seedlings of *Desmodium repandum*in two year study period (July 2010 to June 2012) in the forest in Alwar

This is confirmed by the findings of Sarukhan & Harper[5] and Yadav & Tripathi[18] who suggested that established plants may survive the adverse environmental situations. Sharitz and Mc Carmick[19] suggested that the biotic factors regulate the population through thinning of individuals whereas the abiotic factors through stunting of the individuals in populations of *Sedum smallii* and *Minuartiauni flora*. However, in the present study, it was observed that the populations of both species of *Despmodium* are regulated through seedling mortality caused due to decrease in soil moisture at the end of growing season. The individuals

which managed to survive the unfavourable drought situations, responded to competition due to associated vegetation mainly through plasticity in rest of their lives.

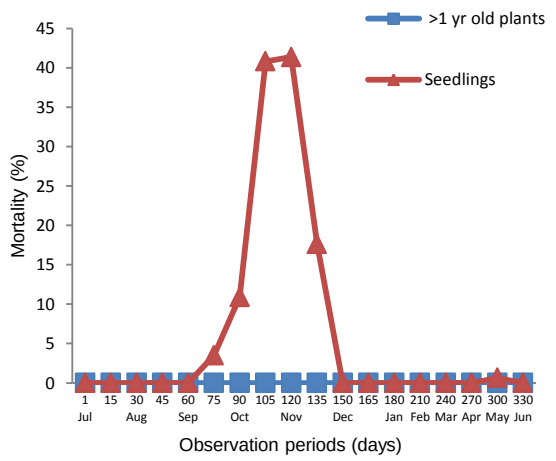

Fig.6: Periodic mortality of *Desmodium gangeticum* population in first year (July 2010 to June 2011) in the forest in Alwar.

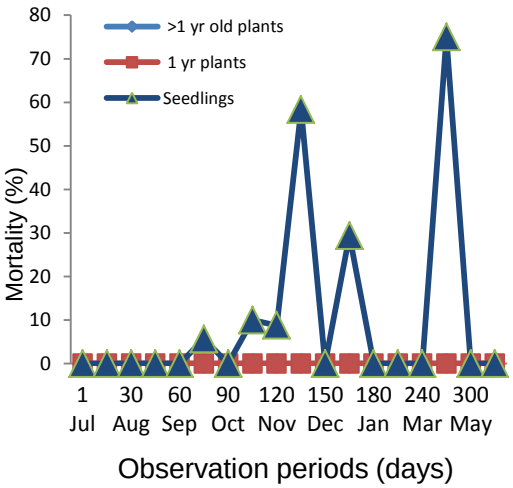

Fig.7 Periodic mortality of *Desmodium gangeticum* population in second year (July 2011 to June 2012) in the forest in Alwar.

Age Structure

The age structure of *Desmodiumgangeticum* exhibits higher population density of seedling age group as compared to older age groups which indicates that population of this species is increasing gradually and stable in this study site (Fig.8). It may be concluded that the populations of *Desmodium repandum* and *Desmodium gangeticum* are stable and increasing in protected forest areas whereas both spcies do not grow in disturbed forest areas in Alwar Rajasthan.

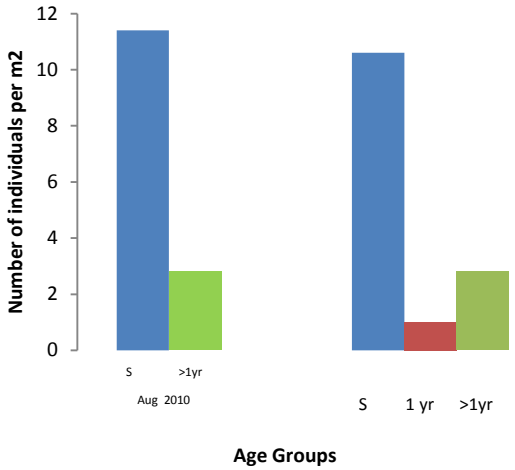

Fig.8:Age structure of *Desmodium gangeticum* population in two year study period (July, 2010 to June 2012) (S = Seedling, yr = Year) in the forest in Alwar.

Acknowledgement

The financial assistance received by Rajendra Prasad through MS-165/304032/10-11/CRO dated 31.03.2011as Minor Research Project, University Grants Commission, Bhopal is gratefully acknowledged.

References

1. Cordell G A 2000, Biodiversity and drug discovery a symbiotic relationship. *Phytochemistry* **55** 463-480.
2. Dahanukar S A, Kulkarni R A and N N Rege 2000, Pharmacology of medicinal plants and natural products. *Indian Journal of Pharmacology* **32** S81-S118.
3. Ji H F, Li X L and H U Xang 2009, Natural products and drug discovery. *EMBO Reports***10** 194-200.
4. Singh, A and R G Saini 2014, Plant biodiversity of Central University of Punjab main campus. *Tehcnical Bulletin No. 01/2014*. Central University of Punjab, Bathinda.

5. Sarukhan J and Harper J L 1973, Studies on plant demography: *Ranunculus repens* L., *R. Bulbosus* L. and *R. acris* L. I. Population flux and survivorship. *J. Ecol*. **61** 675-716.
6. Yadav A S and Tripathi R S 1981, Population dynamics of the ruderal weed *Eupatorium odoratum* and its natural regulation. *Oikos* **35** 355-361.
7. Boutin C and Harper J L 1991, A comparative study of the population dynamics of five species of *Veronica* in natural habitats. *Journal of Ecology* **79** 199-221.
8. Bach C E 1998, Seedling survivorship of the beach morning glory, *Ipomeapes-caprae* (Convolvulaceae). *Australian Journal of Botany* **46** 123-133.
9. Reece P E, Schacht W H and A E Koehler 2004, Stiff sunflower population dynamics on summer-grazed sand hills rangeland. *Journal of Range Management* **57** 590-596.
10. Dey V N and Yadav A S 2010, Allelopathic effects of associated species on *Indigofera trita*. Linn.f. *Indian Journal of Ecology* **37** 70-73.
11. Soni D and A S Yadav 2012, Biology of *Evolvulus alsinoides* (L.) L. and *E. nummularius* (L.) L. Effect of light intensity, soil moisture and population density. *Journal of Phytological Research* **25** 229-233.
12. Dey V N and A S Yadav2008, Effect of grazing on the population dynamics of *Indigofera trita* L. in northeast Rajasthan. *Bulletin of National Institute of Ecology* **19** 20-24.
13. Yadav A S 2001, Distribution and regeneration of *Holopteleaintegri folia* Planch. In Alwar distirict, Rajasthan. *Journal. Bombay Nat. Hist. Soc.* **98**: 217-223.
14. Dwivedi R P and R S Tripathi 1980, Response of *Alysicarpus monilifer* DC. and *Indigofera enneaphylla* L. to selective removal of associates in grassland vegetation. *Proc. Indian Natn. Sci. Acad.* B **46** 207-213.
15. Yadav A S and R S Tripathi 1987, Population dynamics of *Eupatorium adenophorum* Spreng. and *E. riparium* Regel. in relation to burning. *Weed research* **27** 229-336.
16. Jones R H and R R Sharitz 1998, Survival and growth of woody plants seedlings in the under storey of flood plain forests in South Carollina. *Journal of Ecology* **86** 574-587.
17. Welden C W, Hewett S W, Hubbell S P and R B Foster 1991, Sapling survival, growth and recruitment : relationship to canopy height in a neotropical forest. *Ecology* **72** 35-50.
18. Soni D and A S Yadav2010, Population dynamics of *Evolvulus alsinoides* (L.) L. and *E. nummularius* (L.) L. in a tropical dry deciduous forest in Alwar, Rajasthan. *Journal of Phytological Research* **23** 367-372.
19. Sharitz R R and J F McCormick 1973, Population dynamics of two competing annual plant species. *Ecology* **54** 723-740.