STUDIES ON ECOLOGICAL STRATEGIES OF *OXALIS CORNICULATA* LINN. AND *O. LATIFOLIA H.B.K.*

By

ALLANA ROSE LALOO

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Gram : NEHU
Phone (office) : 23390

North-Eastern Hill University
DEPARTMENT OF BOTANY

Dr. R. S. Tripathi
Professor of Ecology

School of Life Sciences
SHILLONG 793 014, INDIA

March 15, 1990.

I certify that the thesis entitled "Studies on ecological strategies of *Oxalis corniculata* Linn. and *O. latifolia* H.B.K.", submitted by Mrs. Allana Rose Laloo, M.Sc. for the Degree of Doctor of Philosophy of the North Eastern Hill University, Shillong, embodies the record of original investigation carried out by her under my supervision. She has been duly registered and the thesis presented is worthy of being considered for the award of the Ph.D. Degree. The work has not been submitted for any Degree of any other University.

R S Tripathi
Signature of the Supervisor

Forwarded
Y. S. Chauhan
15.3.90

Head
Department of Botany
School of Life Sciences
N.E.H.U., Shillong-14

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Aaloo

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(ALLANA ROSE LALOO)
Lecturer in Botany
St. Mary's College
Shillong

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CHAPTER I

General Introduction

Plant populations are generally exposed to continuous changing environment. However, weeds represent the most successful and stable populations and can successfully occupy large areas. Many weed species utilize breeding systems adapted for inbreeding to produce stable duplicates of successful genotypes and as a result, weeds are very good colonisers (Allard 1965, Baker 1974, Young & Evans 1976). Moreover, they possess multiple propagation mechanism and are prolific reproducers. Salisbury (1961) predicts that, "casual weeds of today are likely to become noxious weeds of tomorrow". The weedy species seem to adopt different strategies to persist in natural populations and expand their range of distribution. Thus a proper understanding of the ecological strategies of weeds would be helpful in designing effective control measures.

The characteristics of weeds that ensure their survival and population growth under varied environmental conditions may be grouped under 'adaptive strategy'. As argued by Tripathi and Trivedi (1984), these characteristics contribute to successful exploitation of available resources and continued persistence and proliferation of weedy species. The reproductive strategy as a part of the total adaptive strategy of weeds assumes a special significance as the weed population growth is, in all probability, a direct function of the reproductive success under a given set of environmental conditions (Tripathi & Trivedi 1984). Studies on resource allocation to reproductive structure under different ecological habitats, therefore, constitute an important aspect of the analysis of ecological strategies of weeds.

Cody (1966) used 'r'- and 'K'- strategies in his attempt to study geographic variation in avian clutch size. He observed that birds in seasonal environments allocate more resources to reproduction but in less seasonal environments, populations are nearer to carrying capacity, and more resources are consequently allocated to competitive activities.

MacArthur and Wilson (1967) described the theory of strategies in the light of r- and K- selection. K- selection consists of organisms which allocate more energy to vegetative activities for increased competitive ability. Under r- selection, evolution promotes productivity, high rates of resource exploitation and high reproductive output. These two types of selection lie on the two opposite poles in the evolutionary spectrum. It is now widely accepted that the majority of organisms fall between the extremes of r- and K- selection. More recent evidence suggests that genetic variation may cause populations of the same species to occupy different positions along the r-K continuum (Gadgil & Solbrig 1972).

Grime (1977) proposed that during the course of evolution of plants three basic forms of natural selection known as C-S-R selection occurred. C-S-R strategy model comprise competitive (C), stress tolerant (S) and ruderal (R) strategies. Grime suggests that the ruderal and stress-tolerant strategies correspond,respectively to the extremes of r- and K- selection and that highly competitive species occupy an intermediate position. The C-S-R strategy model differs from the r-K continuum in the recognition of stress tolerant as a distinct strategy evolved in intrinsically unproductive habitats or under conditions of extreme resource depletion induced by the vegetation itself.

Kaul (1985) observes that annual plants generally exhibit the syndrome of 'r' selection. They occupy ephemèral habitats, show high mortality and short lifespans, develop rapidly and recolonize often, reproduce early in their lives and produce numerous small seeds, allocate greater energy and materials to reproduction, and their populations are spatially and temporally variable. Perennials often exhibit 'K' selection, a syndrome whose features are the opposites of 'r- selected' species. Similar observations were made by Pitelka (1977)and Primack (1979). A comparison of the growth strategies of annuals, biennials and perennials showed that biennials are better adapted for exploiting resources in sites that are available only intermittently (Hart 1977).

Stearns (1976) argued that in fluctuating environments, early maturity, production of numerous small young and large reproductive efforts, which are characteristics of r-selected species, are favoured, while in stable environments, late maturity, few seeds and small reproductive efforts are favoured (K-selected species).

Allocation of resources to various parts of the plant is an important aspect in studying the ecological strategies of plants. Bazzaz *et al*. (1987) suggest that at an evolutionary level, allocation involves balancing fecundity against survival probability through the lifespan and the effects of this balance on fitness. At an ecological level, allocation includes the relationship between investment in one function and investment in others, such as the relationship between defence and growth. At a physiological level, allocation entails the partitioning of resources within the plant and the consequences of this partitioning for resource gain or loss.

Harper (1967) emphasized the evolutionary importance of life histories and reproductive allocations of plants. Hickman (1975) suggests that all functions of organisms are ultimately focussed towards maximizing successful reproduction. Studies on the adaptive nature of resource allocation in plants have been undertaken by various workers (Gadgil & Solbrig 1972, Abrahamson & Gadgil 1973, Tripathi & Harper 1973, Ogden 1974, Trivedi & Tripathi 1982a, 1982b, Jurik 1983, Bazzaz & Reekie 1985, McCrea & Abrahamson 1987, Reekie & Bazzaz 1987). Kawano (1981) stressed the significance of ecological distribution, dispersal, survival patterns and mortality factors in addition to measurements of reproductive effort to assess life-history strategies.

Allocation patterns in different plant populations under different competitive regimes have been studied by various workers

(Solbrig & Simpson 1974, Law *et al*. 1977, Wilken 1977, Grace & Wetzel 1981, Trivedi & Tripathi 1982a, Tripathi & Yadav 1982, Rai & Tripathi 1983, Zangerl & Bazzaz 1983). These studies suggest that plant populations in 'closed' habitats are different from populations in 'open' habitats, allocating more to persistence and competition and less to the production of propagules for dispersal. In the light of 'r'- and 'K'- selection, it may be said that populations from open habitats show 'r'- selection and those from closed habitats are 'K'-selected.

The allocation pattern of a plant defines the ecological roles and is, therefore, an important factor in understanding plant distribution and adaptation. Moreover, continued improvement of agronomic species is likely to draw insights obtained through ecological studies of allocation in wild species (Bazzaz *et al*. 1987).

Plant form may also confer an important adaptive advantage to different plant species. A prostrate habit permits maximum ground cover at minimum cost as the requirement for supporting tissue is reduced (Lovell & Lovell 1985). Moreoever, it encourages vegetative spread because these organs are prolific producers of adventitious roots (Lovell & White 1986) essential for the establishment of independent ramets.

The study of ecological strategies of weeds would be primarily concerned with such aspects as the growth responses to different environmental conditions, competitive behaviour, energy allocation to different plant parts and the production of seeds and vegetative propagules.

Several exotic weeds have undergone tremendous range expansion in north-eastern India and many of them have become important pests of agriculture and plantation crops (Tripathi 1985). *Oxalis corniculata* and *Oxalis latifolia* represent two such exotic weeds. They are sympatric perennial species belonging to the family *Oxalidaceae*. They occur in wastelands, arable lands, kitchen gardens, lawns and grow with potted ornamental plants. *O. corniculata* is a prostrate stoloniferous, creeping herb which reproduces vegetatively by rooting at nodes and by seeds which are dispersed forcefully from the capsules away from the parent plant (Robertson 1975, Holm *et al*. 1977).

O. latifolia is a bulbous perennial which undergoes a state of dormancy during the cold and dry winter months with the underground bulbs serving as perennating organs. The bulbs germinate only in late spring. The plant reproduces mainly by vegetative propagation through the production of daughter bulbs. Therefore the bulbs act as perennating organs as well as the organs for vegetative reproduction.

The difference in their life form and differential emphasis placed by them on vegetative and sexual modes of reproduction make them interesting material for the analysis of ecological strategies.

The ecological strategies of these two weeds have been analysed in terms of their growth response and reaction to different ecological conditions. The aspects that have been considered are as follows :

I. Growth of the two Oxalis species in relation to the selective removal of associated vegetation.

II. A comparative growth of O. corniculata raised from seeds and cuttings in pure and mixed stands.

III. Growth of O. latifolia as affected by bulb size.

IV. Effect of light intensity on the competitive interaction between O. corniculata and O. latifolia.

V. Competition between O. corniculata and O. latifolia at two NPK levels under two moisture regimes.

VI. Effect of clipping and 2, 4-D application on competitive interaction between O. corniculata and O. latifolia.

The basic structure of the dissertation is outlined below:-

1. General Introduction (Chapter I) sets out objectives of the thesis.

2. Review of Literature (Chapter II).

3. Description of the study site and biology of the two species of Oxalis selected for the study (Chapter III).

4. Analysis of the ecological strategies of the selected species to varied ecological conditions (Chapter IV - VIII).

5. General Discussion (Chapter IX).

Most of the experimental data collected during the study period have been presented in Chapters IV - VIII and the data contained in each one of them have been discussed in the corresponding chapters. The major results of the entire study however, have been briefly discussed in an integrated manner in "General Discussion" which is followed by "Summary" of the thesis. The references cited in the thesis have been listed at the end.