The thesis embodies the results pertaining to the studies on grass-legume interaction. The species selected for the present study are *Paspalum dilatatum* (a grass) and *Trifolium repens* (a legume). Both species are perennial and grow abundantly in the grasslands of Shillong and adjoining regions, and have good fodder value. They represent a sympatric pair of species but differ in growth habit. *P. dilatatum* has an erect habit and *T. repens* is prostrate growing. Besides, their growth is somewhat asynchronous and one of them, *T. repens*, is capable of exploiting atmospheric nitrogen. Thus, the competition studies between them under varied ecological conditions prevailing in their natural habitats were carried out. A summary of the results of the field and culture pot experiments is given below:

**Effect of simulated grazing and cutting:**

The response of the two species to simulated grazing was studied using 'exclosure technique' in the field condition where both the species were growing together. The herbage was removed at the ground level at three months interval for a year beginning from May 1978. The data on density, total leaf area, total herbage yield and the number of reproductive shoots of the two species were recorded in both the treated and control plots.

The density of *T. repens* was much greater in the treated than in the control set, while *P. dilatatum* showed
the reverse trend. Both species seemed to maintain an equilibrium in density in the treated plot. Leaf area and dry matter yield also showed a trend similar to density. Although, *P. dilatatum* showed slightly stunted growth in the treated plot, it quickly recovered from the herbage removal treatment and was able to produce some flowering shoots, but the reproductive potential was greatly reduced due to the treatment. *T. repens*, on the other hand, showed substantially reduced density, and growth in the protected plot. The severe competition offered by the grass which grew luxuriantly in absence of herbage removal, suppressed the legume substantially. It was concluded that the co-existence of the two species in the grassland of Shillong is possibly due to constant grazing and biotic disturbances operating in nature.

**Effect of season:**

Pure and mixed populations of *T. repens* and *P. dilatatum* were raised in different seasons to study the effect of season on their competitive interaction. Besides these short-term experiments, a long-term experiment was also conducted to study competitive behaviour of the two species over a period of one year.

At each observation period, in both the long- and short-term experiments, the number of stolons or rhizomes, number of leaves, total leaf area, dry matter yield, allocation of dry matter to above- and below-ground plant parts and number
of fertile shoots were estimated.

*T. repens* produced more stolons in pure than in mixed stands while *P. dilatatum* produced more tillers in mixture than in pure stand under long-term experiment. Similar trend was exhibited by leaf area and dry matter yield.

In long-term experiment the flowering of *T. repens* was much lesser in mixture than in monoculture while *P. dilatatum* produced more fertile shoots in mixed than in pure stand both in the long- and short-term experiments.

Both species showed poor growth in winter, but immediately after the winter season i.e. during March-April, *T. repens* showed much better growth. It also showed profuse flowering in April-May when *P. dilatatum* was still in the seedling stage. This asynchronous active growth period of the two species might be helpful in minimizing the severity of competition between them. However, they failed to co-exist in nature for longer period in such situations where herbage removal and biotic disturbances did not exist.

**Competition at varying nitrogen levels:**

Sand culture experiment was carried out using 3 levels of nitrogen to study the effect of soil nitrogen on competitive behaviour of the two species by growing them in pure and mixed stands at the same over-all density.
Both the species suffered due to nitrogen deficiency of soil in the beginning. But with passage of time, the legume (*T. repens*) showed comparatively greater yield and produced more stolons and leaves and even could allocate a part of its resources for sexual reproduction (flowers and fruits) in the mixed stand. The better performance of *T. repens* in mixture at nil nitrogen level could be attributed to relaxed competition from the grass which suffered severe setback due to nitrogen deficiency in the growth medium. At higher nitrogen regimes, however, the legume grew better in monoculture than in mixture.

At lowest nitrogen level ($N_0$) the growth of *P. dilatatum* was greatly suppressed in pure stand but in mixed stand it showed comparatively better growth. Thus it appears that in mixed situation the grass benefits from the legume in terms of nitrogen supply. This is also evident from the higher nitrogen content of the grass in mixture as compared to pure stand. At higher nitrogen levels, *P. dilatatum* grew very luxuriantly particularly in the mixed stands where the legume showed much reduced growth indicating that the grass is a stronger competitor than the legume if the supply of nitrogen was not limited.

**Effect of simulated trampling:**

Under field conditions, the two species are subjected to varying degree of trampling by man and grazing animals. In order to know whether trampling influences the competitive behaviour of *P. dilatatum* and *T. repens*, their pure and mixed
populations grown at the same overall density were subjected to simulated trampling treatment.

Trampling treatment had more severe effect on \textit{P. dilatatum} than \textit{T. repens} and so, the competitive effect of the grass on the legume was minimized where the mixed populations were subjected to trampling treatment. An analysis of growth of \textit{T. repens} in pure and mixed populations in relation to trampling clearly reveals this fact. Although \textit{P. dilatatum} showed better growth in mixture than in monoculture, its growth in mixture was particularly better in absence of trampling. While the grass always contributed more to the combined yield in mixture the percentage contribution by the grass decreased with increase in trampling pressure. The relative yield and fertile shoot production also showed similar trend.

**Competitive interaction as affected by light regimes:**

The two species were grown in pure and mixed stands at the same overall density under two light regimes to examine the effect of light on competition between \textit{T. repens} and \textit{P. dilatatum}.

Under high light regime, the legume produced more stolons in pure than in mixture while at low light intensity stolon production was more in mixed stand. \textit{P. dilatatum}, however, produced more tillers in mixture as compared to pure stand under both the light conditions. Growth of both the species was retarded under decreased light intensity but the decrease in
growth of the legume was more pronounced. Under both the light regimes, the contribution by the grass to the combined yield was much greater than that of *T. repens* and the R.G.R. and N.A.R. values were also higher for the grass.

Under high light intensity, the legume allocated a part of its resources to reproductive structures in pure stand but in mixed populations no flowering was observed. The relative yield values of both species and their RYT were much lesser under low light regime. Besides decrease in light intensity, the competition offered by the grass further contributes to the reduction in growth of the legume.

**Interaction between the two leaf morph populations of *T. repens***:

Two distinct leaf morph populations of *T. repens* were observed to occur in the local grasslands. One population is characterised by having 'V' shaped white marking on the leaflets (white marked population) while the other population has no such leaf marking (unmarked population). The field observations suggest that the two leaf morph populations have differential nitrogen requirement and they grow mixed together in varying proportions. Thus, an attempt was also made to analyse the competitive behaviour of the two populations of *T. repens* as influenced by soil nitrogen and their proportion in mixed stands.

**Effect of soil nitrogen**:

The two leaf morph populations of *T. repens* were grown
in pure and mixed stands in the experimental pots according to de Wit's replacement series under high and low nitrogen regimes. The measurements were made in respect of stolon length, leaf area, number of fertile shoots, dry weight and allocation of dry matter to different plant parts. Besides, chlorophyll content in the leaves and nitrogen content in the aboveground plant parts were also determined.

Both the morphs produced more stolons in mixture than in monoculture at low nitrogen regime. The stolon production by the white morph was stimulated by the addition of nitrogen while the unmarked morph did not show such a behaviour. However, the leaf area per plant of the unmarked morph was greater in mixture at low nitrogen level while under high nitrogen regime, the plants grown in pure stand produced larger leaf area.

Yield of the white morph both in pure and mixed stands increased under high soil nitrogen regime, while the unmarked morph was unaffected by the addition of soil nitrogen. The dry matter allocation pattern of the white marked population was slightly changed due to added soil nitrogen, particularly in the early stages, when the allocation towards leaves was much less and to stolons much greater than the corresponding values at low nitrogen level.

Chlorophyll and nitrogen content, flowering and seed production of the white marked population increased with increase in soil nitrogen. Thus the nitrogen requirement of the white
marked population seems to be higher than that of the unmarked population. The quotient of relative yield values showed that the white marked population was more competitive as compared to the other morph. This confirms the field observations with regard to greater abundance of the white marked population than the unmarked population on fertile soils.

**Growth of the two populations of *T. repens* in relation to their proportion in mixture:**

The two leaf morph populations of *T. repens* were grown in monoculture and mixed stands in different proportions (25, 50, and 75%) at an overall density of 8 plants per pot.

It was observed that the marked population produced greater leaf area in pure than mixed stand, while the unmarked population produced larger photosynthetic area in the mixed stands. However, stolon length and weight of the marked population showed an increase in mixture over the corresponding monoculture values.

Similarly, the dry matter yield of the marked population was also more in mixture than in pure stand. Further, with increase in proportion of the unmarked population in mixture dry matter yield of the marked population increased indicating that the latter population is probably more sensitive to intra-morph competition.

The maximum number of seeds/pot was produced by the
marked population in mixture having equal proportion of the two populations, while the unmarked population produced maximum number of seeds in pure stand. Thus it seems that besides soil nitrogen controlling the abundance of the two morphs, the relative proportion of the two morphs in mixture may also largely decide the outcome of competition between the two leaf morph populations.

Results of the various experiments on competitive interaction between the grass and legume indicate that T. repens, although a weak competitor, plays a significant role in the growth and maintenance of Paspalum dilatatum - Trifolium repens grassland community at Shillong particularly on less fertile soils where the grass may depend, to some extent, for nitrogen supply on the legume. P. dilatatum, being a strong competitor, is capable of completely suppressing the growth of T. repens in the grasslands protected from biotic disturbances. In field situation, the grass, however, absorbs most of the grazing, trampling and cutting pressure, and is rendered weak to offer severe competition to the legume, which therefore can manage to co-exist with the grass under disturbed conditions prevailing in the grassland vegetation at Shillong.