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Response of *Alysicarpus monilifer* DC./and *Indigofera enneaphylla* L. to Selective Removal of Associates in a Grassland Vegetation*

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The reaction of the populations of two leguminous forbs to their major associates in a grassland community has been assessed in the paper. The abundantly growing *Brachiaria distachya* resulted in considerable reduction in the aboveground yield and seed production *of Alysicarpus monilifer* DC. and *Indigofera enneaphylla* L. whilst the dicots like *Desmodium triflorum and Evolvulus nummularius* did not cause growth suppression to that extent. The growth of *I. enneaphylla* while in competition with *A. monilifer* was not reduced so much as the growth of *A. monilifer* in competition with *I. enneaphylla.* The interference from the associates caused 90.5% reduction in seed production of both the legumes, thus restricting the occupancy of ecologic niches by the two species in subsequent generations.

Key Words: *Alysicarpus monolifer, Indigofera enneaphylla,* **Grassland vegetation, Leguminous forbs, Effect of associates**

Introduction

On account of their high palatability, *Alysicarpus monilifer* DC. and *Indigofera enneaphylla* L. suffer a great deal in the grasslands that are constantly exposed to grazing. The two legumes, however have been observed to exhibit better growth in moderately grazed situation than either in protected or in heavily grazed situations (Dwivedi 1978). This indicates that certain other factors like associated species might also influence their growth behaviour in nature.

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The population size and growth of individuals and their distribution may be profoundly modified due to interference caused by the associated species and as consequence, the fundamental niche of a given species may be restricted to smaller hypervolume (Harper 1964). The grasses have been observed to play a major role in limiting the population growth of *Plantago* species (Sagar & Harper 1961) and the order of tolerance of *Rumex obtusifolius* to various water regimes is reversed due to presence of *Lolium perenne* (Harper & Chancellor 1959). The suppression effects of ryegrass on the establishment and production of associated grasses and clovers have also been demonstrated by Cullen (1964). Further, Putwain and Harper (1970) while studying the behaviour of the two species of *Rumex*, *R. acetosa* and *R. acetosella* in a hill grassland of Caenarvonshire have reported that the niche relations of the two species in the sward situation are greatly dependent on the reactions of the associated species. The present communication which forms a part of our study on the population behaviour of *A. monilfier and I. enneaphylla* in field situation seeks to examine the influence of major associates on growth of the two legumes in a grassland vegetation at Gorakhpur.

Materials and Methods

The study was made in field situation following the analytic approach adopted by Sagar and Harper (1961) in which the natural mixed populations are simplified by the selective removal of various species and the influence of the desired species on a given species population is measured in time sequence. Thus, a small plot of a grassland vegetation situated on the campus of the University of Gorakhpur, Gorakhpur was enclosed with the help of barbed wire fencing in order to protect it from disturbances like grazing, scraping and trampling. A series of experimental sub plots of 50 cm^2 size were demarcated in field situation leaving 50 cm wide gap in between the subplots.

The grassland community under study was composed of grasses like *Brachiarea distachya, Bothriochloa pertusa, Cynodon dactylon, Dactyloctenium aegyptium, Dichanthium annulatum, Digitaria biformis, Eragrostis tenella, Panicum psilopodium, Paspalum flavidum* and *Sporobolus diander* and dicots like *Alysicarpus monilifer, Boerhavia diffusa, Desmodium triflorum, Euphorbia hirta, Evolvulus nummularius, E. alsinoides, Heliotropium strigosum, Lindernia ciliata, Vernonia cineria* and *Zornia gibbosa.* The sedges like *Cyperus rotundus* and *C. triceps* were also present. Of these plant species, *B. distachya* was the most abundant followed by *A. monilifer, D. triflorum, E. nummularius* and *I. enneaphylla* while other species were present in small numbers.

The experimental design consisted of a randomised plot design with 5 treatments × 3 replicates — 1 harvest for each of the two species. The following five treatments were maintained in the field situation.

A. monilifer or *I. enneaphylla* grown alone.

A. monilifer grown with *I. enneaphylla* or *I. enneaphylla* grown with *A. monilifer.*

A. monilifer or *I. enneaphylla* grown with grasses.

A. monilifer or *I. enneaphylla* grown with dicots.

A. monilifer or *I. enneaphylla* grown with all the species.

The experiment was started in the last week of June, 1974 immediately after the first monsoon showers and was terminated by November when *A. monilifer* and *I. enneaphylla* reached their peak reproductive growth. Fifteen of the surviving seedlings of the two legumes were allowed to grow to adult plants in each treatment and their growth was measured at the end of

November, 1974 in relation to different associates. Thus, in each of the experimental quadrats, the density of *A. monilifer* or *I. enneaphylla* was maintained at 15 plants per 50 cm^2, a density that was generally encountered in the grassland under study in natural situation.

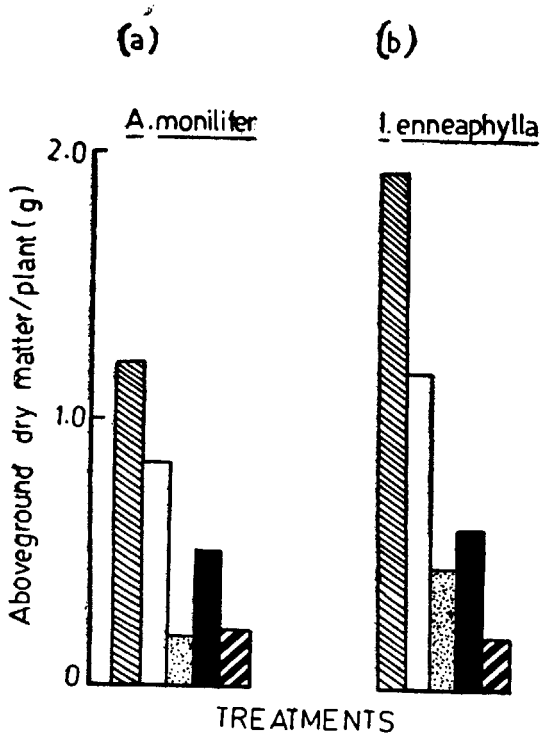

Figure 1 Aboveground yield per plant of *A. monilifer* (a) and *I. enneaphylla* (b) when grown with different associated species under field situation. Treatments are:

- *A. monilifer* or *I. enneaphylla* grown alone
- one legume grown with the other
- a given legume grown with grasses
- grown with dicots
- and grown with all the species

Results

Response of A. monilifer when grown with various associates

A. monilifer when grown alone produced greater number of fruits and seeds and greater amount of dry matter per plant than when it was allowed to grow with various associates. Its growth was observed to be considerably suppressed because of associates (table 1, figure 1).

Effect of I. enneaphylla

A. monilifer showed poor growth when it grew in competition with *I. enneaphylla* as indicated by the reduction in various growth parameters like number of fruits and seeds per plant and dry matter production, caused due to presence of *I. enneaphylla* in the field plots (table 1, figure 1).) The magnitude of reduction in seed production of *A. monilifer* was 60% when it grew in competition with *I. enneaphylla* (table 3).

Effect of grasses

The interaction of grasses especially *Brachiaria distachya* which was abundantly growing in the grassland vegetation under study caused an appreciable suppression in growth of *A. monilifer*. Almost all the growth characters measured, showed drastically reduced values because of competition from grasses (table 1). The production of fruits and seeds per plant of *A. monilifer* was found to be reduced to the extent of 88% and 90.9% respectively (table 3). A substantial reduction in growth of *A. monilifer* caused due to interference from grasses may be attributed to the shade offered by the grasses which usually grow taller than the prostrate growing *A. monilifer*. The prostrate growth habit of the species was changed to erect in presence of the grasses indicating that the competition for light was more crucial.

Effect of dicots

The dicots like *Desmodium triflorum* and *Evolvulus nummularius* also suppressed the growth of *A. monilifer*. The number of branches, fruits and seeds and also dry matter per plant of *A. monilifer* showed considerable reduction (table 1, figure 1). However, the reduction in growth in this case was not that high as due to grasses (table 3).

A. monilifer grown with all the species

When grown in competition with all the species, *A. monilifer* showed a considerable decrease in fruit and seed production, and aboveground yield per plant (table 1). The seed output and fruit production exhibited a reduction of 90.5% and 88% respectively (table 3).

Growth of I. enneaphylla in competition with various associates

I. enneaphylla grew luxuriantly when it was free from competition offered by the associates (table 2). The aboveground yield and fruit and seed production were much greater when it was growing alone than when growing in competition with the associates (table 2, figure 1).

Effect of A. monilifer

A perusal of table 2 and figure 1 shows that *I. enneaphylla* also suffers to some extent in the presence of *A. monilifer*. The seed output and number of fruits per plant of *I. enneaphylla* in the presence of *A. monilifer* were reduced to the exent of 14.6% and 14.7% respectively (table 3). A comparison of competitive effects of *A. monilifer* are *I. enneaphylla* on each other indicates that the growth of *I. enneaphylla* while in competition with *A. monilifer* is not reduced to that extent as the growth of the latter in competition with the former (table 2).

Effect of grasses

The number of branches, fruits and seeds and aboveground dry matter per plant of *I. enneaphylla* decreased considerably due to competition from grasses (table 2). In the presence of grasses, there may be a keen competition especially for light, and the species not only showed substantial reduction in various growth parameters but also lost its usual prostrate habit and assumed an erect form. The seed output and fruit production of *I. enneaphylla* were reduced considerably due to presence of grasses, the extent of reduction being 66.7% and 71.2% respectively (table 3).

Effect of dicots

Amongst the dicots, the two most abundantly occurring plant species that influenced the growth of *I. enneaphylla* are *Desmodium triflorum* and *Evolvulus nummularius*. The aboveground yield, fruit production and seed output of *I. enneaphylla* grown in competition with the dicots, were all reduced as compared to control treatment where the species was growing alone i.e. free from competition offered by the associated species (figure 1).

I. enneaphylla grown with all the species

I. enneaphylla suffered still more heavily when all the species were allowed to compete with it (table 2, figure 1). The percentage reduction in seed output and number of fruits per plant caused due to interference from all the species was very high, 90.5% and 90.6% respectively (table 3).

Discussion

Both the legumes, *A. monilifer* and *I. enneaphylla*, showed a considerable reduction in vegetative and reproductive growth due to competition offered by the associated

Table 1 *Growth of* Alysicarpus monilifer (*A*) *as affected by various associates in field situation* (*Mean** ± *Standard Error*)

Characters	'A' grown alone	'A' grown with *I. enneaphylla*	'A' grown with grasses	'A' grown with dicots	'A' grown with all the species
No. of branches per plant	10.5±0.8	12.9±1.6	5.4±0.5	9.5±0.6	5.3±0.3
No. of fruits per plant	10.0±2.5	4.2±1.1	1.2±0.5	4.0±1.2	1.2±0.4
Seed output per plant	28.7±8.1	11.5±2.9	2.6±1.3	10.0±3.0	2.7±0.8
Aboveground yield per plant (g)	1.200±0.13	0.839±0.16	0.314±0.02	0.500±0.01	0.186±0.05

*Values represent average of 15 plants

Table 2 *Growth of* Indigofera enneaphylla (*I*) *as affected by various associates in field situation* (*Mean** ± *Standard Error*)

Characters	'I' grown alone	'I' grown with *A. monilifter*	'I' grown with grasses	'I' grown with dicots	'I' grown with all the species
No. of branches per plant	19.0±3.0	15.2±1.6	5.3±0.5	12.5±1.9	5.3±0.5
No. of fruits per plant	95.5±14.3	81.4±19.4	27.5±7.6	44.0±11.6	9.0±2.1
Seed output per plant	191.0±27.8	163.0±3.50	63.5±17.6	88.0±23.2	17.8±4.1
Aboveground yield per plant (g)	1.920±0.28	1.170±01.17	0.449±0.10	0.584±0.24	0.168±0.02

*Values represent average of 15 plants

Table 3 *Percentage reduction in seed output, fruit production and aboveground yield per plant of* A. monilifer (*A*) *and* I: enneaphylla ('*I*') *due to associates**

Characters	*A. monilifer* grown with:				*I. enneaphylla* grown with:			
	'I'	Grasses	Dicots	All species	'A'	Grasses	Dicots	All species
Seed output	60.0	90.9	65.1	90.5	14.6	66.7	53.9	90.5
No. of fruits	58.0	88.0	60.0	88.0	14.7	71.2	53.9	90.6
Aboveground yield	30.0	73.8	58.3	84.5	39.0	76.6	69.6	91.2

*This set of data has been reported by Tripathi and Dwivedi (1978) in *Glimpses of Ecology* as well

species. The study reveals (tables 1 and 2, figure 1) that the two leguminous forbs when freed from competition by the neighbouring grasses responded by an increased production of dry matter, branches, fruits and seeds. Such a response has also been reported by Cronin (1976) who found an increase in production of grasses and sedges on plots where tall larkspur and other broad leaf species were effectively removed. The grasses seem to be mainly responsible for regulated the growth and seed production of the two legumes and any change in seed producing capacity of plants is bound to affect the population growth in time and space.

The habit of the two legumes is changed from prostrate to erect in presence of the grasses which is a strong indication that the grasses offer keen competition especially for light. The change in growth habit was also accompanied by a substantial reduction in growth and vigour. The study reveals that dicots like *Desmodium triflorum* and *Evolvulus nummularius* also bring about some reduction in vegetative and reproductive growth of the two legumes. Surprisingly enough, the effects of grasses and dicots were not additive and the extent of reduction caused by the grasses alone was almost same as that caused by the grasses and dicots together. It appears that the competitive influence of *D. triflorum* and *E. nummularius* on *A. monilifer* and *I. enneaphylla* is greatly reduced in presence of the grasses. This is further substantiated by the fact that in field situation, *D. triflorum* and *E. nummularius* show greatly suppressed growth in presence of grasses and are reduced too weak to cause any additional reduction in growth of *A. monilifer* and *I. enneaphylla*. Thus, the absence of any appreciable difference between the suppression in growth of *A. monilifer* and *I. enneaphylla* caused by grasses alone and by the grasses and dicots together may be partly explained on the basis of the susceptibility of the dicots to competition from the grasses.

As mentioned earlier, the competitive influence of the grasses especially abundantly occuring *Brachiaria distachya* on growth of the two legumes was spectacular. *A. monilifer* when grown in competition with grasses showed 90.9% reduction in seed output and 73.8% in aboveground biomass (table 3). *I. enneaphylla* also showed a considerable plastic response to competition from the grasses but the reduction was not that great as in *A. monilifer*. The interference from the associated species may thus exercise a profound influence on the ecologic niches of these two species in restricting their growth to a smaller hypervolume. Putwain and Harper (1970) while studying the influence of associated species of growth of *Rumex acetosa* and *R. acetosella* populations have also argued that in the presence of grasses and dicots, the fundamental niches of *Rumex* spp. are modified considerably. In the present study, the grasses have been found to exert strong suppressing influence on the vegetative growth and reproductive behaviour of the field populations of *A. monilifer* and *I. enneaphylla*. Both the species suffer considerably due to lack of sufficient open space and light for their photosynthetic activity and they gradually acquire an erect form under the influence of vigorously growing associates especially the grasses. In the grassland under study, it was also observed that these two leguminous species grown in close proximity of the grasses, either failed completely or partially to produce the root nodules (Dwivedi 1978) and thus, the nitrogen supply to these plants is also curtailed to some extent on account of competition from the associates. The restriction in the fundamental niches of the two species in presence of the associates may largely be attributed to the resource

competition amongst various species populations. However, the possibility that the associates might also influence the legumes through allelopathic effects as reported by Murty and Nagodra (1977) in case of *Indigofera cordifolia*, may not be excluded.

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