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A CONTRIBUTION TO THE AUTECOLOGY OF *CAPPARIS DECIDUA* (FORSK.) EDGEW.

I. Seed germination and the effect of topograhpic conditions on the growth, abundance and sociability.

M. Qaiser And S. A. Qadir

Department of Botany, University of Karachi, Karachi- 32, Pakistan.

Abstract

The good mechanism of pollination and the large production of the seeds and fruits are responsible for the wide distribution of *Capparis decidua*. Seeds have high percentage of germination but lose their viability with the lapse of time. After two months the germination reduced from 96% to 58% and after four months it remained only 28%. Moderate warm temperature is needed for the establishment of seedlings and their rate of growth is very slow. Vegetative prropagation takes place by roots only. Relative turgidity of *Capparis decidua* remains constant throughout the year (85% average) indicating the possibility that its roots always remain in contact with under ground water table. There are 9 amino acids in the seeds as shown by chromatographic results. Phenology is irregular however it is affected by topographic factors to some extent. Growth abundance and sociability are greatly affected by the topographic conditions. Best growth was observed in lowlying areas along with sociability class I but reverse was true for the abundance. On sand dunes highest abundance was found alongwith sociability class II, with poor growth. On flat plains and foothills intermediate growth and abundance was found, while the sociability was class I.

Introduction

Capparis decidua (Forsk.) Edgew. is one of the dominant species of West Pakistan. It is widely distributed throughout the arid and semi arid areas of West Pakistan plains.

Very little autecological work has been done in Pakistan. Although certain phytosociological and synecological work have been carried out but they do not throw much light on the ecology of the individual dominant species. Little is known about the ecology of *Capparis decidua* (Forsk.) Edgew. and it is mainly through synecological studies. In the present work the main objective was to find out the precise environmental factors which control the growth and abundance of the plant in the southern part of West Pakistan. An attempt was made to correlate the various edaphic, and physiographic factors with the growth, sociability and abundance of the plant in nature.

Review of Literature

The pioneer botanists of Indo-Pakistan sub-continent were mainly interested in the flora of the country. The ecological thinking started with the establishment of the Forest Research Institute at Dehra Dun, alongwith the publication of Indian Forester (1874). The work actually began with the studies of plant succession and successional changes in the vegetation of the Upper Gangetic plain (Dudgeon, 1920). Mukerjee (1920) worked on the ecology of Mercuriales, Saxton (1922-24), Burns, Chakardev, Phadnis and Kulkarni (1921-1927) studied the plant succession of the xerophytic Indian grassland,

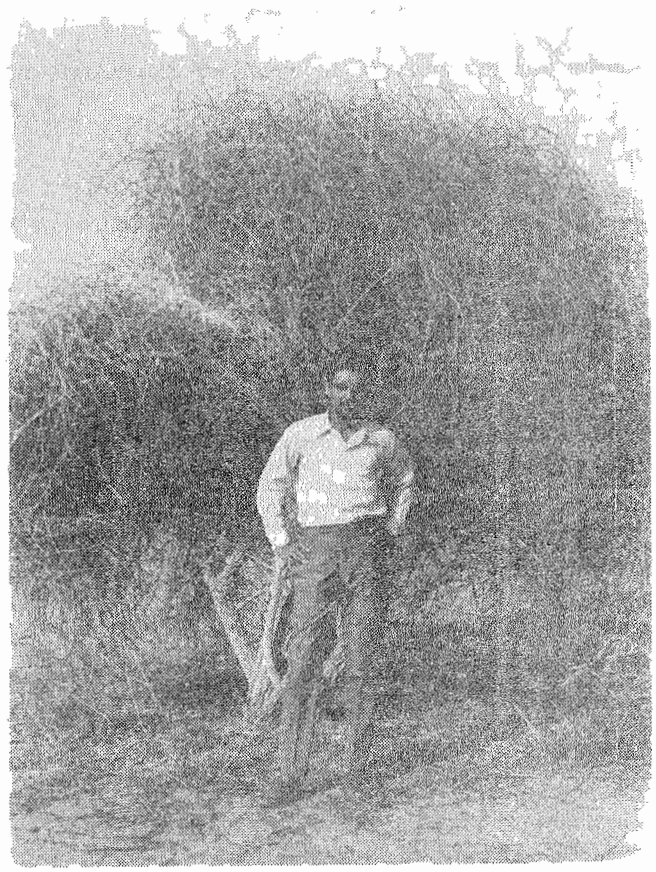

Fig. A gigantic bush of *Cappairs decidua* growing near Long Lachar.

Singh (1925), Gowan and Champion (1924) also made important studies on the forests of Indo-Pakistan sub-continent

Generally, the early botanists paid more attention to the vegetation of moist regions. Deserts received less attention and the study of arid and semi arid zone vegetation was entirely neglected. Burkill (1910) was attracted by the arid zone vegetation of Baluchistan and published a working list of the flowering plants of Baluchistan. Later on Blatter, Halberg and Sabnis, (1921) described the vegetation of Jodhpur, Jaisalmir and also certain parts of Sind. Blatter, McCann and Sabnis (1918) described the flora of Indus Delta with a few ecological notes on local species.

Autecological studies were mostly confined to the trees of high economic value like *Tectona grandis* and *Shorea robusta* (Anonymous). Mukerjee (1932) seems to be the first to enter into the field of autecology and studied the genus *Artemisia* and its species found in Kashmir. In the same year Panfakar studied the germination of *Eichornia crassipes*. Almedia and Desai (1942) made a study of *Jussieae suffriticosa* Linn. and *Ludwigia parviflora* Roxb. Misra and Rao (1948) worked on the autecology of *Lindenbergia polyantha* Royle and found out that *Lindenbergia urticaefolia* Lehm. and *L. polyantha* Royle, were not two different species but were simply the ecotypes, *polyantha* being a calcicole and the other growing on ordinary soil. Later on various workers like Srivastava and Tandon, (1952) worked on the autecology of *Trapa bispinosa* Roxb. Srivastava and Tandon (1951 & 1952) studied the autecology of *Anisochilus eriocephalus* Benth. Pandeya (1953) worked on the morphology and ecology of 3 species of *Dicanthium*, and Bakshi (1954) worked on the autecology of *Mollugo cerviana* Ser. Mall (1956) worked out autecology of *Chrozophora rottleri*. In 1958 he also studied the autecology of *Cassia torra* and *C. obtusifolia* Linn. Joshi and Kambhoj (1959) studied the autecology of *Gisekea pharnecoides* Linn. Puri (1959) worked on *Casuarina equisetifolia*. Krishanan (1962) made some contributions on the autecology of *Euphorbia hirta* Linn. In 1963 he also contributed to the autecology of *Setaria glauca*.

The work done in Pakistan is of synecological nature. However, certain limited aspects of autecology have been investigated such as seed germination. Chaudhri (1951) worked on the germination of the seeds of *Atropa belladona* Linn. Afridi (1951), while working on the cultivation of *Acacia molissima* and *A. decurrens* found that seeds should be treated with boiling water for 24 hours and sown before monsoon. Brockway and Rahman (1956) worked on the introduction of *Eucalyptus* species in West Pakistan. They found that the best irrigation method to obtain the highest percentage of germination in *Eucalyptus* was by percolation from below the bottom-less beds. Khan (1957) worked on the growth and cultivation characteristics of medicinal and other economic plants. Chaudhri (1957) studied the seed germination of *Podophyllum emodii* Wall. Ahmed (1959) worked out the distribution, ecology, economic importance, physiology and propagation of *Haloxylon recurvum* Bunge. Khan and Hussain (1962) while working on *Datura stramonium* Linn. found out that the more suitable period under semi-temperate condition for sowing seeds is that of March. Ahmed (1962) worked on the germination of *Diospyros melanoxylon* and found out that fresh seeds gave better percentage of germination. Qadri (1962) while working on the same plant found that the 7 months old seeds gave only 30% germination. Khattak (1962) worked on the germination of *Nannorrhops ritchiana* and *Olea cuspidata* and found that former gives best results in water; an alternating temperature of 102°F and 28°F for about 3 weeks resulted in germination indicating that seed dormacy in dwarf palm required thermoperiodicity. In the latter, the locality from where the seeds were collected had highly significant effects on seed germination.

Chaudhri (1962) carried out autecological studies on *Amaranthus fimbriatus* and *Polygonum plebejum*. Chaudhri (1960) also worked on *Suaeda fruticosa*. The

main object of the Chaudhri's work was to study waterlogging and salinity problem. The plant was found to withstand waterlogged conditions successfully.

Ahmed (1964) worked on the seed germination of *Acacia arabica* Willd. and found that fresh seeds gave better results. He also found that soaking of seeds for four hours in hot water, speeds up germination to a great extent. Malik (1965) showed that in *Nigella sativa* the germination percentage was better in cold season. Khan (1965) determined the best time for sowing of *Cenchrus ciliaris, Elionurus hirsutus, Prosopis spicigera, Zizyphus jujuba* and *Z. nummularia*. He found that the best time for sowing for these plants is from 1st July to 15th August. Muftee (1966) studied the effect of salt concentration and soil water on the ecology of *Cynodon dactylon* and *Eleusine flagellifera*. He concluded that the former species is highly tolerant to salinity at the stage of germination while the latter is highly sensitive.

In recent years detailed autecological studies have been carried out. Baig and Qadir (1966) worked out the autecology of *Commiphora mukul* Engl. In the same year Majeed and Qadir, Akbar and Qadir worked on the autecology of *Cordia rothii* and *Indigofera oblongifolia* respectively. Hussain and Qadir (1970) studied the autecology of *Euphorbia caducifolia* and Habinun-Nisa and Qadir (1969) studied the germination behaviour of some of the wild plants and cultivated trees.

Geology, physiography and climate of the study area

The study area lies in Karachi district which is entirely a sea borne land and the rocks found in its neighbourhood belong to upper Tertiary. Karachi and Sind owe their origin to the rising of extra peninsular mountains from Tethys sea. The land rose and fell and rose again until during Miocene age Karachi area was occupied by gulf of sea. Further fluctuations again produced temporary inversion. General cooling of climate took place in the ice age and in post-tertiary period conglomerate was laid down as fluvagile deposit (Pithawala, 1948).

Karachi district lies between the latitude 24°-40′ - 25°-15′ - North and between the longitude 65°-51′ —67°-40′ East. It is bounded in the west by Hub river, on Sind Baluchistan border by the coastal line of Arabian sea. The alluvial plain which is formed by the 3 rivers Lyari, Malir & Hub is rich in vegetation. Sand dunes occur frequently in the region which are of both coastal and inland origin. The hills are of calcarious nature and the highest recorded peak is 582′ from sea level. The western border of upper Sind is skirted by Kirthar range which lies from north to south along Baluchistan border. The Kirthar range is related to Pab range which runs parallel to Kirthar range (Pithawala, 1948).

The meterological data are not available for stations in the immediate neighbourhood of Karachi. Therefore the climatic conditions of Karachi will be discussed. The representative stations for Karachi are Manora (coastal) and civil airport (Inland). Naqvi (1956) carried out the detailed analysis of raintall pattern for the last hundred years.

The average annual rainfall is 7.75″ out of which 6.16″ are received during monsoon period from June to September. In the rest of the months average monthly rainfall remains below 0.5″. Great variation in the annual rainfall was found by Naqvi (1956) during 1856-1955. On twentyfour occasions the rainfall was higher than 10″ and in 1869 there was the highest rainfall of 28″ and on 3 occasions the average rainfall was less than 1″. The year may be divided into rainy season lasting from June to September and dry season lasting from October to May (a continuous period of 8 months). The coastal regions like Cape Monze, etc. and inland regions like Dhabeji, Gharo, etc. show a considerable variation in the temperature. The areas which are closer to sea have a maritime trend but inland regions have continental character. Manora shows less difference in the range of diurnal temperature as compared to the airport station. The daily range of temperature at Manora is more than 19°C in three winter months of November, December and January. From February to May with the rise of relative humidity it decreases rapidly. During monsoon period from middle of June to middle of September it gets reduced to 8°C only. At civil airport the daily range is as high as 27°C to 30°C during the period of October to March due to its continental character (Chaudhri, 1961). The hottest month is June and the coldest is January and the whole area is free from frost.

The strong coastal winds which are characteristic of this region, blow mostly from South West and West-wardly direction and constantly carry sand and salt particles from beach to the interior. During the month of November to February wind mostly blows from land to sea (from North and North East direction). At places like coastal regions of Cape Monze, Paradise Point, etc. the wind velocity reaches upto 25 miles per hour.

Geographical distribution of *Capparis decidua* (Forsk.) Edgew.

The plant is widely distributed, and has been regarded by Blatter, McCann and Sabnis (1929) as the tropical and North African-Indian desert element. It is distributed in north and tropical Africa, orient and India (Jafri, 1956). It has been reported from all the sandy tracts of Indo-Pakistan sub-continent (Talbot, 1911). Griffith (1932 (K)) has reported from Afghanistan (without locality).

Taxonomy of the plant.

Capparis decidua (Forsk.) Edgeworth in Journal Linn. Soc., Bot. vi, 184. (1862).

Synonyms:-

(1) *Sodada decidua* Forsk. Fl. Aegypt-Arab, 81. (1775).

(2) *Capparis aphylla* Roth. Nov. pl. sp. 238 (1821); F.B.I. 1: 174. 1872.

Vernacular names:-

(1) Karir (Sindhi)

(2) Dela (Punjabi)

Morphological description of the plant has been given by Hooker (1879), Parker (1956), Jafri (1966), etc.

Economic Importance

The wood is used for beams and rafters in roofs and knees of boats in Sind, also for oil mill and agriculture implement. The wood also provides cheap fuel for villagers. it is a bitter wood which is not attacked by white ants. The unripe fruits are collected in the Punjab and Sind and used for making pickle, commonly known as Dela-Da-Aachar in the former province. The roots are immense and spreading, acting as a good sand binder. The twigs are grazed by cattle.

Materials and Methods

To study the autecology of *Capparis decidua* in detail, weekly field trips were arranged in an area of 60-70 miles around Karachi.

1. **Field observations**

Phenology: Various phenological stages such as flowering, fruiting, disspersal of seeds were noted down in each site from the beginning till the end of study (October 1966—August 1967).

Abundance: The abundance of *Capparis decidua* was estimated in each community. The estimation of the abundance was done by assigning appropriate abundance classes of Braun-Blanquet (1932).

Growth: Randomly 25 plants were selected and their height and circumference were measured by a measuring tape. The data included all possible variation in the sample population of each site.

Associates: The community associates of *Capparis decidua* were also noted by visual observation. The dominant species of the community were noted down.

Sociability: Sociability of the plant was recorded and expressed in terms of Braun-Blanquet's (1932) classes.

Topography: The topographic features of each stand were noted.

Soil Collection: Soil samples of surface and sub-surface levels were collected by means of soil auger from each locality.

Fruit Collection: Large number of fruits were collected from different stands in

order to study the differences in shape, size and weight of fruits and seeds in different communities.

2. **Laboratory work**

(*a*) *Morphology of seeds and fruits:-* From the collected fruits 75 were picked up randomly and their diameters were measured with the help of vernier calliper and the shapes of the fruits were also noted. Average number of seeds per berry were recorded and the average weight of the seeds was determined.

(*b*) *Seed germination:-* Different treatments were given to the seeds in order to find out the highest percentage of germinantion. Twenty-five seeds were randomly taken and placed on moist filter paper in petri dishes for each treatment. The seeds were stored and germination of stored seeds was also tried.

(*c*) *Green House studies*

(*i*) Seeds were sown at different depths i.e. half an inch, one inch, two inches and 3 inches in two different soil types, viz. fine sand and silty clay loam.

(*ii*) *Transplant of Seedlings:* Seedlings were transplanted in order to measure the rate of growth of seedling and to determine the best period for its establishment.

(*iii*) *Vegetative Propagation:* In order to ascertain whether the plant propagates vegetatively or not, the cuttings of the shoots and roots were planted in the pots.

(*d*) *Relative Turgidity:* The relative turgidity of the shoot of *Capparis decidua* was determined regularly every month by the method of Weatherly (1950).

Result and discussion

Diseases of *Capparis decidua*

The fruits of *Capparis decidua* are attacked by an insect which could not be indentified. The fruits which had been collected from the various localities appeared quite healthy outwardly but when they were broken it was found that seeds were eaten up or infested by the larvae of the insect. Under storage it was observed that the infested fruits (which appeared quite healthy outwardly), developed small pustule like spots which were shining and papery.

Most probably the insect lays its eggs on the stigma or infests the flowers and then parasitises the ovary and passes the early stages of its life cycle in the fruits. Fruits which are dispersed are usually infected by a number of saprophytic fungi which completely destroy the seed. The saprophytes are as follows:

(*i*) *Cladosporium sp.*
(*ii*) *Helminthosporium sp.*

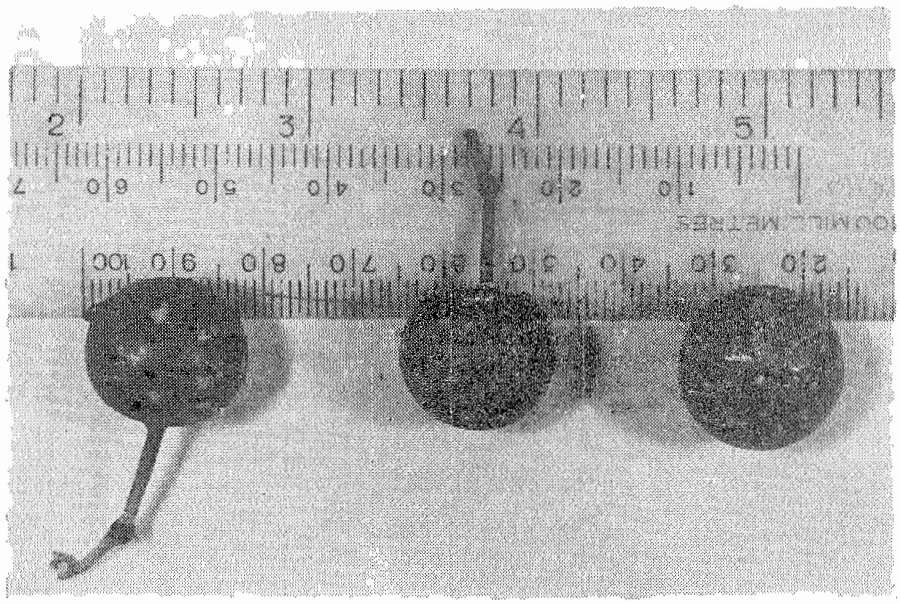

Fig. 2. Fruits of *C. decidua* showing insect infestation.

(*iii*) *Curvularia sp.*
(*iv*) *Aspergillus sp.*

Dispersal of Seed and Fruits

As in berries, the dispersal of seeds is not very good. Birds are the most important dispersing agent. It was observed very frequently that the empty fruits were still attached to the plant but the seeds are eaten up by the birds. The dispersal of seeds takes place through their feces. Wind currents also carry the seeds to some extent.

Human beings also seem to be important factor in dispersing seeds and fruits. The plant is cut down for fuel purposes. Many fruits are detached and they are thus dispersed to some extent.

Pollination

The flowers are large and showy and the insects are greatly attracted. In the pollination various types of insects are involved. Some of the common insects are as follows:

(1) *Camponotus compressus*
(2) *Danis plexippus*
(3) *Rufa formica*
(4) *Colotus etrida*

The good mechanism of pollination and the large production of fruits appear to be responsible for the wide distribution of *Capparis decidua*.

Morphology of Seed and Fruit

The berry is dark red when ripe, the number of seeds present in a berry varies from 1 to 31. Fruit is globose or sub-globose ranging from 2-8 cm, in diameter and it is slightly beaked, glabrous and smooth. There seems to be a significant effect of soil texture and topography on the size and shape of the fruit. For instance, on the sand dunes (i.e. sandy soil), the fruits are more or less ovoid in shape having a diameter of 0.7-1.6 cms while in the low lying area having fine soil, the fruit was oblong in shape having pointed beak, the diameter varied from 0.8 – 2 cms and on the flat area the fruits appeared to be intermediate between the two (sand dunes and lowlying area). The results are based on 5 samples from 5 different stands.

Seed germination

Large number of seeds were taken out from the red berries and different treatments were given. The results are tabulated in Table 1.

In an another experiment the berries were thoroughly dried in the sunlight for a week and then the seeds were used in seed germination experiments. The results are shown in the table 2

Germination of seeds collected from the Punjab

The seeds were collected from the Punjab in the month of January and their germination was tested in February. The results are tabulated in Table 2.

The same seeds of experiment No. 1 were stored in a polyethyene bag for 2 months. They were kept for germination and results are tabulated in Table 2.

The stored seeds lost their viability after 4 months. The results of germination are tabulated in Table No. 2.

Germination of stored seeds from the Punjab

After four months the percentage of germination was very low. In control only 4% germination was obtained. (Table 2)

Effect of soil depth on germination

Very few seedlings of *Capparis decidua* were observed in the field. Therefore it was considered that the seeds of *Capparis decidua* may have low percentage of germination in soil. The seeds were sown in pots having different types of soil at different depth. These pots were irrigated daily and care was taken to ensure proper drainage. The results are given in Table 3. The seeds which were sown at different depths in different soils were stored seeds of two months

Table 1. Seed germination of fresh seeds from ripe berries.

Treatment	Total No. of seeds	No. of days needed for 1st germination.	No. of days needed for last germination.	Percentage of germination.
1	2	3	4	5
1. Control	25	7	17	96
2. Kept at 30°C	25	4	21	68
3. Ethylene gas	25	5	27	84
4. 1% Thiourea				
(i) 1 minute	25	7	27	52
(ii) 2 minutes	25	6	27	60
(iii) 3 minutes	25	6	25	72
5. 2% Thiourea				
(*i*) 1 minute	25	6	31	72
(*ii*) 2 minutes	25	5	29	76
(iii) 3 minutes	25	7	36	80
6. Acetone				
(i) 1 minute	25	6	25	76
(ii) 2 minutes	25	6	31	84
(iii) 3 minutes	25	5	33	92
7. Boiling water				
(i) 1 minute	25	17	41	24
(ii) 2 minutes	25	15	—	12
(iii) 3 minutes	25	—	—	—
8. Sulphuric Acid				
(i) 1 minute	25	7	18	64
(ii) 2 minuts	25	7	24	80
(iii) 3 minutes	25	8	23	84
(iv) 5 minutes	25	4	29	72

Contd.—

Contd.....Table 1.

1	2	3	4	5
9. Mechanical injury (Sand paper)	25	4	14	12
10. Immersion in water for different periods				
(i) 24 hours	25	4	32	56
(ii) 48 hours	25	4	23	72
(iii) 72 hours	25	5	32	80
(iv) 90 hours	25	5	22	64
11. Continuous dark	25	—	—	—
12. Hcl treatment for 1 minute	25	8	29	64
13. Potassium nitrate				
(i) 1 minute	25	6	31	56
(ii) 2 minutes	25	5	28	64
(iii) 3 minutes	25	5	27	64
14. O° Centigrade	25	—	—	—
15. 60° Centigrade	25	—	—	—
16. 40° Centigrade	25	5	29	32
17. Alternate heating and cooling	25	—	—	—

Table 2. Germination behaviour of *Capparis decidua*

Treatment	Total No. of seeds	No. of days for 1st germination	No. of days taken for last germination	Percentage of germination
Seeds from fruits dried in the sunlight				
Control	25	17	39	64
Acetone 1 minute ..	25	14	36	48
,, 2 minutes ..	25	16	39	52
,, 3 minutes ..	25	14	31	60
Seeds collected from Punjab				
Control	25	31	28	32
Acetone 1 minute ..	25	18	25	24
,, 2 minutes ..	25	17	24	32
,, 3 minutes ..	25	14	25	32
Seeds stored for 2 months				
Control	25	14	29	58
Acetone 1 minute ..	25	15	31	24
,, 2 minutes ..	25	14	28	22
,, 3 minutes ..	25	17	36	34
Seeds stored for 4 months				
Control	25	16	29	28
Acetone 1 minute ..	25	21	28	12
,, 2 minutes ..	25	18	31	8
,, 3 minutes ..	25	14	34	20
Punjab seeds stored for 4 months				
Control	25	31	–	4
Immersed in water for 72 hours	25	14	15	8

Germination of seeds from one year old fruits

The work on the autecology of *Capparis decidua* was undertaken in October, 1966. During the early field trips the fruits were collected which were about one year old. The fallen fruits were also collected.

Most of the fruits were infected by saprophytes or insects. However the healthy fruits were tried for germination and these seeds showed reduced viability, in control only 8% germination was obtained.

From the results following inferences are drawn:-

1. The seeds do not have any external or internal dormancy, because in every case the best result was obtained in the control.

2. Fresh seeds give better germination and they lose viability with the lapse of time. The percentage of germination in fresh seeds was about 96%. The stored seeds after two months gave 58% and the seeds which were stored for four months gave only 8% germination.

3. The embryo of the seed is very delicate because in the boiling water treatment only 24% germination was obtained. When boiled for two minutes only 12% germination rsulted and no germination was obtained when the seeds were boiled for 3 minutes. The results of mechanical injury also indicate that it has delicate embryo because only 12% germination was obtained.

4. The seeds require light for their germination because in complete darkness no germination was obtained. Pot culture experiments also indicate its light requirement for germination as in sandy clay loam at 2″ and 3″ depth no germination was obtained. However, in fine sand at 1″ depth the percentage of germination was 16% only.

5. The results of germinations of seeds collected from different geographical areas indicate that the seeds are not similar in germination behaviour. This points out the possibility of geographical differentiation of populations.

6. The optimum temperature for the germination seems to lie in the range of 28° C. to 30°C. Above 40° C, no germination was obtained.

Mode of Geemination:

The seeds imbibe water and testa swells up. After 6 or 7 days the testa cracks up at the depression. The radicle comes out and elongates at the expense of food material stored in the cotyledons. The rate of elongation of radicle is very slow. The hypocotyle forms an arch and coming out of the cotyledonary leaves is very slow. It takes 6- 8 days after germination to produce a complete seedling. The mode of germination is epigeal.

Table 3. Effect of soil depth on germination.

Texture of soil	Depth of sowing	Total No. of seeds sown	No. of days for 1st germination.	No. of days for last germination.	Percentage germination.
Sandy clay loam	1″	25	30	41	8
,,	2″	25	–	–	–
,,	3″	25	–	–	–
Fine sand	1/2″	25	16	21	16
,,	1″	25	18	34	16
,,	1½″	25	21	36	8

Morphology of seedling

The seedling has the primary root having large number of root hairs. The cotyledonary leaves are equal in size and lanceolate in shape dark green in colour and are persistent for a long time.

Transplant of seedlings

Several attempts were made to transplant the seedlings in the month of December, January and February but they did not survive. The seedlings which were grown in the petri dish were transferred to the pots containing fine sand and sandy loam but the seedlings could not be established. In the middle of April another attempt was made and in this case one seedling was collected (from Hub Chowki) and transplanted and other seedlings from petri dishes were also used. The collected seedlings could not survive but the seedling which was transferred from the dish was successfully established. This indicates that the seedlings require warmer temperature for their establishment rather than cooler temperature. Since the months of December, January and February are the cooler months in Karachi so the seedlings could not be established while the middle of April is quite warm thus favoured the establishment.

This view is further supported by the fact that during all the weekly field trips starting from October, 1966 upto April, 1967, we could not get any seedling with the exception of some in April, because it rained in April. The seeds germinated, because the rain coupled with moderate temperature, facilitated germination and establishment.

Rate of seedling growth

Capparis decidua is very slow growing plant. This was observed by the pot culture experiment. The cotyledonary leaves remain attached with the plants for two and a half months. First pair of leaves appeared after one month, it was observed that about three months old plant had only six leaves (including two cotyledonary leaves), the pair of spines appeared after two weeks after the appearance of first pair of leaves; the girth of the stem did not increase appreciably. The seedling was studied for about 2 and half months. During this period the growth increment was measured after every fifteen days. The seedling showed an average increase of 0.1 cm/2 weeks indicating its slow rates of growth. (Table 4).

Table 4. Rate of growth during two months' study.

Month		Growth in Centimeters	Time
May	The first pair of leaves appeared	.2	2nd. Week
May	The first pair of spines appeared.	.1	4th. Week
June	The Cotyledonary leaves were shed	.1	6th. Week

Vegetative propagation

It was observed in the field that people usually cut down the plant for fuel purposes leaving only the roots. After some time the plant propagates itself and it seems as if a new plant is sprouting. The vegetative propagation takes place by means of roots. The roots produce the aerial branches and a single plant covers a large area and a person who is not familiar with this phenomenon may get the impression as if there are many plants growing. In order to prove that the plant propagates vegetatively two different experiments were performed. In one case cuttings of the shoots were brought in the laboratory and transplanted in the pots. In another experiment cuttings of the root with small aerial branches were brought and transplanted. Both were irrigated regularly. It was found out that in the first experiment the shoots did not survive after 15 days, while in the latter case the roots got established and produced branches and leaves. This experiment clearly proved that the vegetative propagation in *Capparis decidua* takes place by means of roots only.

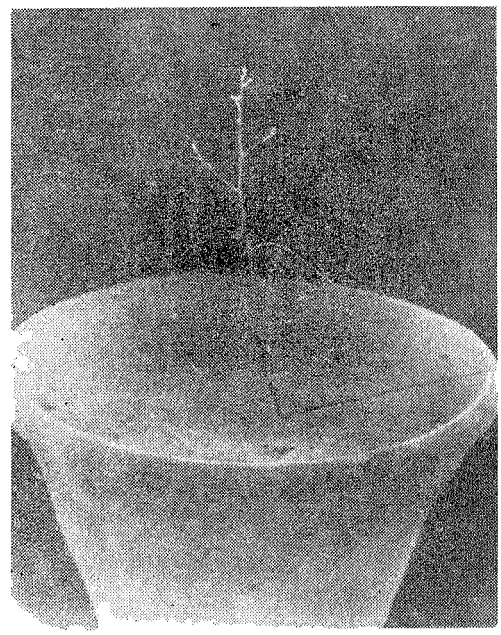

Fig. 3. Twig of *C. decidua* showing vegetative growth.

Relative turgidity

The internal water balance in *Capparis decidua* was studied for a period of 7 months, from December, 1966 to June, 1967. The relative turgidity was found to be uniformly constant throughout the study period. Even after rainfall in June, it remained constant. This constant feature clearly indicates that the roots of *Capparis decidua* always remain in contact with ground water table and thus the plant is able to withstand drought periods very successfully. (Table 5).

Chromatography result

The chromatography of the seeds of *Capparis decidua* revealed that it has nine amino acids. The possibility of using seeds as a source of food for the livestock seems to be fairly good. The seeds also seem to be an important source of food for wild life.

Table 5. Relative turgidity of *Capparis decidua* during different months.

Name of the Month	Relative turgidity %	
December 1968	84.8	
January 1967	84.9	
February	85.4	
March	84.8	(after rain fall)
April	85.1	(after rain fall)
May	86.3	
June	85.6	(after rain fall)

Environmental factors:

Phenology

The phenology of the *Capparis decidua* was observed in all the stands during the field trips. The plant remains leafless throughout the year. Only the young shoots bear the succulent leaves which are shed very soon. There is no definite period of flowering and fruiting in this plant. It appears that it flowers and fruits throughout the year. The phenology is greatly affected by the topography, i.e. moisture conditions. In heavy soil and lowlying area where the moisture conditions are better there is a definite flowering and fruiting period. It starts flowering in February and fruiting starts in the end of March. The ripening of the fruits starts in the beginning of May. Thus the fruits ripe before monsoon period and they are dispersed just before rainy season, which is favourable for seed germination, as they do not require any pre-conditioning for germination except moisture.

On the other hand, in the case of sand dunes and flat topography there seems to be an irregular phenology because in such cases flowering and fruiting were observed in two different periods i.e. December and July besides the normal months, February and March. In such cases the plant flowers and fruits twice or thrice a year.

Influence of topography on growth, abundance and sociability

The differences in the topography seem to have a great effect on the growth, abundance and sociability of *Capparis decidua*. The stands which were sampled had the following divergent type of topographic features:

(*i*) Sand dunes
(*ii*) Flat plains (mostly alluvial)
(*iii*) Low lying areas
(*iv*) Foot hills and sloping ground.

Fig. 4. A pure community of *C. decidua* on sand dunes showing high abundance with poor growth.

The relationship among topography, growth, abundance and sociability is shown in table 6 which clearly indicates that the growth is best in low lying areas and this may be due to better soil moisture regime. On the foothills and sloping areas growth is not good, probably because of excessive runoff resulting in xeric condition. On the sand dunes intermediate type of growth was observed. Moisture conditions here seem to be better than the sloping areas and foot hills. On the flat areas the growth is slightly better than the sand dunes.

The abundance seems to be the reverse of growth, while sociability does not show any great variation. Only two classes of sociability of Braun-Blanquet (1932) were met with. Table 10 indicates that sociability is directly correlated with abundance and topography. It is class II on sand dunes, while on low lying areas, flat plains and foot hills, it is class I (with few exceptions). On the sand dunes the abundance is in the range of 35 to 100%, the plants grow in small tufts and in sandy soil the germination is better (as indicated previously under seed germination studies). Therefore, the individuals grow closer to one another. While in low lying areas where abundance ranges from 5 to 20%the sociability is mostly class I, because the germination is not very good in fine textured soil (low lying areas usually consist of fine textured soils). On flat plains the abundance class ranges from 20 to 35%,(with few exceptions).

Table 6. Effect of topographic conditions on *Capparis decidua*.

Sl. No.	Locality	Topography	Growth Cover	Growth Height	Abundance %	Sociability %
	1	2	3	4	5	6
1.	Near Hub Chauki	Low lying area	42.3′	11.2′	5 - 10	I
2.	Near Lunglohar	-do-	30.3′	13.0′	5 - 10	I
3.	7 miles from Hub Chauki toward Pab range	-do-	28.1′	8.8′	10 - 15	I
4.	6 miles from Hub Chauki toward Pab range	-do-	27.3′	7.6′	10 15	I
5.	24 miles from Karachi towards Thatta	-do-	25.6′	7.04′	10—15	I
6.	39 miles from Gharo on way to Karachi	-do-	23.7′	6.5′	30 35	II
7.	4 miles from Mango-pir near Bund Murad	-do-	22.0′	7.3′	15 20	I
8.	35 miles from Karachi on way to Thatta	-do-	16.0′	5.8′	40 45	II
9.	21 miles from Karachi on way to Pabbni	Flat plains	22.8′	7.0′	35 - 40	II
10.	About 3 miles from Dhabeji towards Thatta	-do-	22.7′	8.4′	40 - 50	I
11.	Near Malir Cantt.	-do-	20.6′	6.7′	20 25	I
12.	Near Sassi Punnu garden	-do-	20.5′	9.0′	05 –10	I

1	2	3	4	5	6
13. 4 miles from Malir on way to Gadap	-do-	18.4′	6.08	70 - 80	II
14. 29 miles from Karachi near Salar Goth.	-do-	18.0′	6'0′	50	II
15. 3 miles away from Sona pass towards Karachi.	-do-	17.8′	4.3′	20– 25	I
16. About 3 m les from Dhabeji towards Thatta	Sand dunes	20.8′	9.3′	80 - 100	II
17. 3-4 miles from Gharo on way to Karachi.	-do-	19.6′	6.8′	50	II
18. 1 mile away from Gadani towards Karachi	-do-	19.4′	6.4′	25– 30	II
19. Near Sona Pass	-do-	19.3′	5.3′	2 – 5	I
20. On way to Hub Chauki, near Mangopir	-do-	18.2′	7.6′	5 - 10	I
21. Karachi University Campus	Sand dunes	15.2′	7.6′	40 –45	I
22. 2-3 miles from Malir towards Khadeji fall	-do-	14.7′	6.6′	50 - 55	II
23. 3-4 miles from Landhi north	-do-	14.6′	6.8′	70 - 80	II
24. 2 miles from Mango-pir near Kalukuhar	Foot hills	19.6′	8.0′	5 – 10	I
25. Near Sona Pass	-do-	16.1′	6.0′	below 2	I
26. Near Makli Sharief	-do-	12.4	4.3′	below 2	I

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