

THE REPRODUCTIVE CAPACITY AND NUTRITIVE VALUE OF *CALLIGONUM POLYGONOIDES* LINN.

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ABSTRACT

Calligonum polygonoides Linn. is monoembryonic and endospermic having epigeal germination. Natural plant populations have three categories of seeds : large, medium and small. The optimum temperature for seed germination in petri dishes was $20 \pm 2^\circ$ C. The average percentage germination was 68.0 ± 5.35 . The average seed output was very high (38177 ± 15469) and varied with the size of the plant. The reproductive capacity was 25960 as the seed/fruits were damaged by the insects even before ripening and shedding. The endosperm of the seed contained starch (37.25%) and crude protein (12.9%)

INTRODUCTION

In north-western part of Rajasthan with xeric environment and hostile climate, regeneration of desert plant is either from the underground perennating parts or by germination of seeds. Survival and distribution of species are affected by not only germination behaviour (Went 1948; Datta and Chakravarty 1962) but also the amount of seed output and regeneration by vegetative parts, collectively called reproductive capacity (Sant 1963).

Calligonum polygonoides Linn. (Phog) was selected for such a study because of its economic importance as a source of fuelwood and fodder (Shakhawat 1961) and its ecological value in sand dune stabilization by producing long and spreading roots. The present study therefore deals with the seed characteristics, germination, seed output, reproductive capacity and nutritive value of *Calligonum polygonoides*.

MATERIAL AND METHODS

Seeds were collected in the month of April/May 1990 from Jorbeer, Bikaner (Rajasthan). The morphology of seed was studied by recording the seed shape, size, weight and volume. Germination was studied in large and healthy seeds, collected from the plant in May. The small seeds were nonviable and damaged by the insects before maturation.

The large sized seeds were soaked over night, sterilized with 0.1% mercuric chloride solution and washed with distilled water. These seeds were kept on moist filter paper in petri dishes (15 cm diameter in four replicates of 25 seeds in each). The germination was observed upto 15 days at different temperatures (15 to 35°C) in the B.O.D. incubator.

Reproductive capacity was determined by finding average seed output per plant. Six healthy plants of different sizes, viz. height 163.58 ± 11.77 cm and crown diameter 587.78 ± 61.7 cm, growing on stabilised sand dunes were selected. In the end of March each plant was well protected by fixing gunny bag sheets all around each plant. The seeds dispersed from each plant were collected within the protective sheets and picked up daily and stored separately. All the seeds from each plant were collected, air dried and weighed. Five replicates of 100 seeds each from every plant were weighed separately. The average number of seeds produced was determined in the following way :

$$\text{Total number of seed per plant} = \frac{100}{y} X$$

Where x = Total weight of all seeds per plant.

y = Weight of 100 seeds.

The reproductive capacity was determined by standard method (Salisbury 1942).

$$\text{Rep. Cap.} = \frac{\text{Average seed output} \times \text{Average percentage germination}}{100}$$

The endosperm of the seed was removed and separated from their cotyledons and analysed for starch and crude protein content by standard procedures. The young shoots of the plants were also chemically analysed for crude protein, nitrogen free extract, total carbohydrate, calcium and phosphorus by standard methods (A.O.A.C. 1975). Crude fiber was determined by Knowles and Walkin (1947).

RESULTS AND DISCUSSION

Seed characters :

In *Calligonum polygonoides* Linn., the single seed remains enclosed in nut type fruit. The single seeded fruit is treated as seed unit as it is not segregate from the fruit. The mature fruit/seed is decanter type with bulbous base and tapering neck (Fig. 1). The three categories of seeds in the mixture from all the six selected plants were large, small and medium sizes in the ratio of 3 : 1.5 : 1 respectively (Table 1).

The large seeds were twice in length (6.43 mm) than breadth (3.08 mm). In smaller ones the length (4.60 mm) and breadth (1.83mm) decreased proportionately.

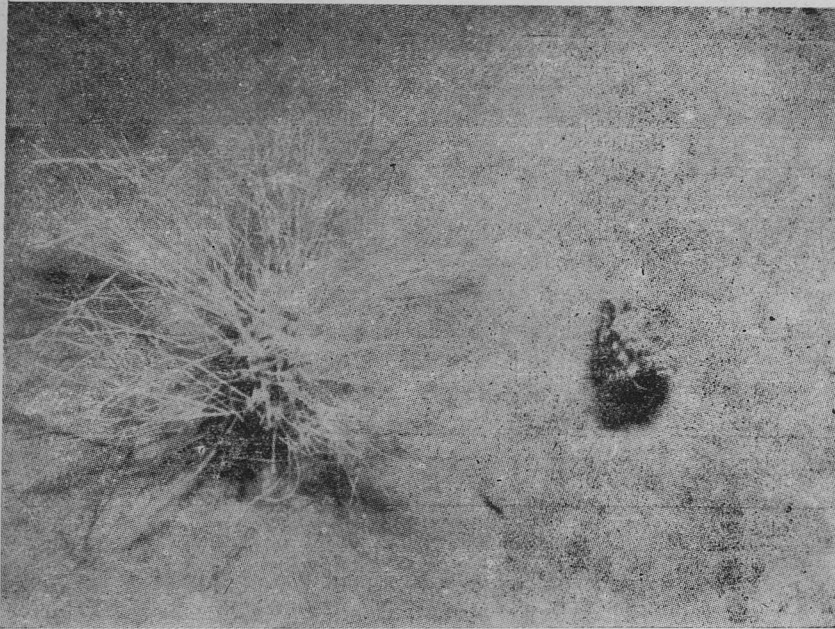


Fig. 1. Seeds of *Calligonum polygonoides* Linn. with bristles and without bristles

Table 1 : Seed characters of *Calligonum polygonoides* Linn.

Parameters	Seed size		
	Large	Medium	Small
Distribution in seed population (%)	52.25	18.70	29.05
Average weight of 100 seeds (mg) with bristles	2289±54.0	1505±46.0	1220±15.9
Average weight of 100 seeds (mg) without bristles	1721±25.0	1109±85.0	820±18.0
Length of seed (mm)	6.43±1.10	5.40±0.95	4.60±1.15
Breadth of seed (mm)	3.08±0.65	2.42±0.69	1.83±0.72
Shape index (L/B)	2.08	2.23	2.44
Size index (L x B)	19.80	13.07	8.64
Volume of 100 seeds (ml)	2.0	1.5	0.8
Length of bristles (mm)	15.0±2.1	12.0±2.21	8.0±3.1

Large seeds (22.89 mg/seed) constituted 52.25 per cent, medium seed (15.05 mg/seed) 18.70 percent and small (12.20 mg/ seed) 29.05 per cent of total seeds in the mixture from all the plants. Shape index (length/breadth=2.44 mm) was higher in smaller ones

than larger seeds. This shows that the small seeds are thin and narrow due to lack of food content in the endosperm. The size index (length X breadth=19.80mm) was more in larger seeds and correlated with weight and volume due to stored food.

Germination :

The germination was epigeal type. It was observed that $20 \pm 2^\circ\text{C}$ was the most suitable i.e. optimum temperature for germination (Table 2). There was no germination below 17°C and beyond 30°C . Thus the minimum and maximum temperatures for germination were 17°C and 30°C respectively. At optimum temperature ($20 \pm 2^\circ\text{C}$) the germination started on fifth day of soaking and rate was very erratic. In the beginning the rate was 20% and on 4th and 5th day of initial observation the increase in rate of germination was 20% and 7% respectively (Table 3).

Table 2. Seed germination of *Calligonum polygonoides* Linn at different temperatures

Temperature $^\circ\text{C}$	Percentage germination after 15 days of soaking
15	—
17	48 ± 4.30
20	66 ± 3.21
22	68 ± 5.35
25	60 ± 4.10
28	40 ± 5.18
30	25 ± 4.10
35	—

Table 3. Dynamics of seed germination of *Calligonum polygonoides* at optimum temperature $20 \pm 2^\circ\text{C}$

Days of observation	Percentage germination
1—5	—
6	20 ± 4.30
7	20 ± 4.30
8	26 ± 5.18
9	46 ± 8.38
10	53 ± 6.19
11	60 ± 3.09
12	60 ± 3.09
13	60 ± 3.09
14	62 ± 4.33
15	66 ± 6.19
16	66 ± 6.19
17	66 ± 6.19
18	68 ± 5.35
19	68 ± 5.35
20	68 ± 5.35

Reproductive Capacity :

The reproductive capacity of the plant is low (25960.68) in comparison to seed output (38177.472 ± 15469.247 , Table 4). The average number of seeds damaged by the unidentified insects in the early stages of development were 4772.184 (12.5% of total seed population per plant). This might be due to high levels of starch (37.25%) and crude protein (12.9%) in the endosperm (Table 5). Under natural conditions if the seeds are not picked up immediately after shedding the extra of damage further exceeds to 25%. It might be due to insects or some unknown agents that scoop out the starchy endosperm. Thus the reproductive capacity under natural environment condition would be further decreased. Reproduction by vegetative parts was not observed, only regeneration from coppice branching takes place during wet periods.

Table 4. Average plant growth, seed output and reproductive capacity of *Calligonum polygonoides* Linn.

Height (cm)	Plants Crown diameter (cm)	Seed output per plant	Damage of seed		Percentage germination	Reproductive capacity
			%	No.		
163.58 ± 11.77	587.78 ± 61.72	38177.472 ± 15469.247	12.5	4772.184	68.0 ± 5.35	25960.68

Nutritive value :

The reproductive capacity of plants not protected from biotic stress will be lesser than this because the tender shoots along with flower buds and young fruits are browsed by the camel. The analysis of young shoots of *Calligonum* showed crude protein 6.41%, crude fiber 23.13%, nitrogen free extracts 62.1%. Total carbohydrates and phosphorus were 81.99% and 0.11% respectively (Table 5). Gaur et al. (1980) and Saxena et al. (1989) recommended that *Calligonum polygonoides* is a good fodder for camel in the arid zone.

Table 5. Chemical composition of shoot and seed of *Calligonum polygonoides* Linn.

SHOOT						SEED	
Crude protein	Crude fiber	Nitrogen free extract	Total Carbo- hydrate	Calcium	Phosphorus	Crude protein	Starch
6.41 ± 0.16	23.13 ± 0.97	62.1 ± 1.07	81.99 ± 0.86	2.14 ± 0.16	0.11 ± 0.05	12.9 ± 0.55	37.25 ± 0.33

All values in percentage.

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REFERENCES

- A.O.A.C. 1975. Official methods of analysis. Association of Official Analytical Chemists. 12th ed. Washington, D.C.
- Datta, S.C. and Chakravarty, H.C. 1962. Germination studies on the seed of *Citrullus*. Indian Agriculture 6 : 220-222.
- Gaur, D.D., Purohit, G.R. and Mathur, C.S. 1980. Nutritive value of phog (*Calligonum polygonoides*) for camels in Rajasthan Desert. Transactions of Indian Society of Desert Technology 5: 29-31.
- Knowles, F. and Walkin, J.E. 1947. A Practical Course in Agricultural Chemistry. Macmillan and Co. Ltd., London.
- Salisbury, E.J. 1942. The Reproductive Capacity of Plant. G.G. Bell and Sons. London.
- Sant, R. Harshwardhan 1963. Ecological studies with special reference to reproductive capacity in relation to grazing of *Dactyloctenium aegyptium* Beauv. Proceeding National Institute of Science, India 30 : 36-46.
- Saxena, N.B., Lata, S. and Mathur, S.K. 1989. Top feed production of phog in desert. Transaction of Indian Society of Desert Technology 14 : 103-106.
- Shakhawat, S.S. 1961. *Calligonum polygonoides* Linn. A very useful shrub in Bikaner. Science and Culture 27 : 40.
- Went, I.W. 1948. Ecology of desert plants. I. Observations on germination in the Joshua tree National Monument. Ecology 29 : 242-253.