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Studing The Agrobotanical Traits And Average Seed Output For Statistically Calculating The Reproductive Capacity Of *Cassia Obtusifolia* L

DrAnubhutiTiwari

Associate Professor Botany Government College Dudu (Jaipur)

ABSTRACT

Establishment and colonization of herbaceous plants in semi-desert area is often a critical stage. Many plants grow along roadside areas of Jaipur during rainy season and make a green belt helping in reducing soil erosion , reducing dust pollution caused by vehicular smoke and also gives asthetic value to the city. Hence a study was conducted on naturally growing plant*Cassia obtusifolia* ascoloniser for the barren land. A field study was conducted around three selected sites of suburban area of Jaipur and data was collected. Ecophysiology, agrobotanical traits, seed size-number and reproductive capacity was calculated by taking statistical one way ANOVA F test.

Keywords : establishment, agrobotanical traits, survival capacity, reproductive capacity

Introduction

Colonisation and subsequent success is quite often a critical stage in the life history of herbaceous plants. Baker (1962) explained these plants as weeds growing very much in place a very special place our cultivated fields, settlements and roadsides. These plants are Agrestals (enter agricultural land) and Ruderals (growing in wasteland or along roadsides). The polluting quality of sandy dust is not easily appreciated even by literate persons except those who have got knowledge of biology. In India all sort of stray animals defaecate on roadsides Joshi and Swami (2007). Unfortunately, even children are often seen faecating on roadsides. All this faecal matter which contains harmful microorganisms sooner or later becomes part of sandy soil which gets easily blown into houses and pollutes many eatables and drinkables inside houses. There is also no check on people throwing garbage outside their houses which ultimately become part of the sandy roadsides and other bare areas.Austrheim,et. al. 2005 ecologically, the most stressful condition in the semi-arid region of Rajasthan is drought which is related to scanty rainfall and soil remains sandy for most of the year. The stress causes a reduction in dry matter production rate of all or a part of vegetation, hence, limiting plant biomass by causing its destruction (Grime, 1979, Chepil, 1949)

Colonization stratagies efficient dispersal and high survival capacity of offspring in new habitat, besides dispersal itself, depends on reproductive characteristics, such as germination and vegetative spread as well as ecological demands of species are usually considered to determine colonisation success of species during succession (van der Valk 1992). Weiher*et al.* (1999) indicated that some of the traits important for colonisation and establishment of species are seed size, plant height, specific leaf area and leaf dry weight.).Most of the ecologists believe that ecological traits do have a strong relationship with plant frequencies and that species

richness is related to habitat variation, obviously with a low stress level (Grime, 1979)Successful colonisers show following features i.e. annual habit, wide environment tolerance during growth, striking developmental homeostasis, tolerance to grazing, extension of seed germination over a long period, large number of progeny, wide dispersal, wide amplitude of modificational plasticity and relatively fast individual development. (Baker, 1958; Stebbins, 1950, 1957 and 1958; Morley, 1960; Grant, 1958; Darlington, 1939 and Ehrendorfer, 1963)

Study Material

Cassia obtusifoliaLbelonging to familyFabaceaesub familyCaesalpinioidae commonly known as *C*offee bean, Java bean, Sicklepod, Senna coffee, White fedegoso in English and Charota in Hindi. These are herbaceous plants growing in open land and roadside areas of Jaipur. They cover the barren land giving greenery, reducing dust pollution and soil erosion and gives aesthetic value to the city.

Distribution- *C. obtusifolia* is native to the American tropics. It is found throughout America, Asia, Africa and Oceania. In India it is distributed to North Western parts of India including Punjab, Rajasthan and Madhya Pradesh.*C. obtusifolia* occurs in grassy fields, disturbed land, roadsides and waste places.

Botanical Description-*Cassia obtusifolia* is erect, bushy, annual, herb up to one meter high. Stems are erect, angular and glabrous. Leavespinnately compound 7.0-15 cm long and comprised of four to six leaflets that are obovate to oblong, rachis is grooved, more or less pubescent with a conical gland between the lowest pair of leaflets. Flowers are usually in subsessile pairs in the axil of leaves, pedicel is one to three cm long. Calyx has five free sepals, glabrous, long, ovate and acute. Petals five, yellow, subequal, oblong, obtuse, upper petal truncate. Stamens are ten out of which seven are fertile and three sterile (staminodes). The ovary has numerous ovules, stigma is oblique with an acute rim. Fruit is a brownish-green, subterete, obliquely septate, containing 30-35 seeds. Pods are slightly indented between the seeds. Seeds are rhombohedral, 5.0 mm long, shiny and yellowish brown to dark red.

Chemical Composition andMedicinal Properties Seeds contain chrysophanol, obtusin, aurantio-obtusin, rhein, torachryson and vitamin A(Zhang *et al*., 2009).Seeds of *Cassia obtusifolia*possess anti-inflammatory activities, acute inflammation in eyes or visual acuity,for itchy, painful eyes and lacrimation. The leaves are used in vomiting, stomachache and headache. They are sauteed in castor oil and used as purgatives and laxatives to improve intestinal transit, poor gut motility and ulcers.*C.obtusifolia*which is known as "Juemingzi" in China is a source of traditional herbal medicine. Its seeds decrease the levels of serum total cholesterol and triglyceride which markedly reduce incidence and death rates of coronary heart disease. It removes the "heat" from the liver and act as antiallergic and antioxidant. In addition to this seeds of Sicklepod showed neuroprotective effects in Parkinson's disease. *C. obtusifolia*accumulate high Cadmium concentrations in roots and therefore, is used for rehabilitating contaminated soil by process called phytoremediation (Attila *et al*., 2001; Laspina *et al*., 2005; Toppi and Gabbrielli 1999; Abe *et al*.**,** 2008 and Elizabeth, 2005).*C. obtusifolia*shows antimicrobial activity against bacterial and fungal infections including gonorrhea, pneumonia, diarrhoea, urinary tract and some mycotic infections along with seeds show larvicidal activity against A*edesaegypti*, *Aedestogoi* and *Culexpipiens*(Dougharie*t al*., 2008).Leaves of *C.obtusifolia* are high in protein content (14.4%) and are highly palatable to poultry as dietary supplements in livestock. The seeds are a source of Cassia gum, a food additive usually used as a thickener and also as a substitute for coffee. A HPLC fingerprint for the identification of Sicklepod has been developed due to its immense medicinal use in the pharmaceutical industries.

Study Site and Methodology

This study site is natural population of plants growing along roadsides and open land in suburban areas of Jaipur at three sites of different localities were selected for experimental study for statistical analysis of pigment content chlorophyll a, chlorophyll b and carotenoids using Arnon (1949) method 50 readings of plant height, number of branches per plant, total number of fruits per plant , total number of seeds per plantwere studied as per the methods given by Misra (1968) and Pandeya, Puri and Singh (1968)**.**Mature seeds were collected carefully before they were shed, if the dispersal is quick, the fruits as well as plants were tied with a cloth to trap the seeds to avoid contamination and mixing with other plant material. The collected seeds were used for calculating seed germination percentage, average seed output and reproductive capacity. Average seed output of plants containing more than one seed was calculated as given by Salisbury (1942).

Average seed output = Number of seeds per fruit (mean) × number of fruits per plant (mean)
± standard error of means

Community structure of an area is expressed by measuring its frequency using Quadrat method given by Oosting (1958). Twenty quadrats (1mx1m) were placed at each site for calculation of frequency class given by Raunkaiaer (1934).

$$\text{Frequency \%} = \frac{\text{Number of quadrats in which species occurred}}{\text{Total number of quadrats studies}} \times 100$$

$$\text{Reproductive capacity} = \frac{\text{Average seed output} \times \text{Seed germination\%}}{100}$$

Observations

The pigment content of plant leaf studied are chlorophyll a, chlorophyll b and carotenoids. The chlorophyll a content was 0.85±0.03 at site A(highest) and 0.75±0.04 at site C(lowest) with one way ANOVA F ratio 4.4673. The chlorophyll b content obtained at site B was 0.51±0.005 and 0.26±0.037 at site C with one way ANOVA F ratio 2.5989. The carotenoid content was 1.13±0.062 at site A and 0.66±0.028 at site C with one way ANOVA F ratio 96.1165. (table1)

The Agrobotanical characters as plant height, number of branches per plant, number of fruits per plant were recorded in Table 1. Plant height(cm) of *Cassia obtusifolia* is highest at site A 122±42.14 and lowest 89.5±29.53 at site C with one way ANOVA F ratio1.9242*. The number of branches per plant in *Cassia obtusifolia* was highest at site B 21.01±2.05 and lowest at site C 18.02±2.46with one way ANOVA and the F ratio is 1.6678*. Number of leaves per plant of *Cassia obtusifolia* is highest at site A 1357±24.90 with one way ANOVA F ratio 1.9306*. Leaf Area (mm)was highest at site A with 205±38.01 and lowest at site B 186±38.78 with ANOVA F ratio 0.6287* The number of fruits per plant of *Cassia obtusifolia* is highest at site B 139.6±10.36 with one way ANOVA F ratio 1.0919* (table 2)

The data of seed characterslike seed size and number of seeds/plant, average seed output, seed germination percentage, reproductive capacity and frequency are recorded in (table3)

Seed length(mm) was 4.23±0.71(highest) at site A with one way ANOVA F ratio 0.1796* and seed width(mm) 2.70±0.39 (highest) at site B with one way ANOVA F ratio 0.3065*The seed germination percentage was recorded in *Cassia obtusifolia* at 70% at site B(highest) one way ANOVA F ratio 10.9375 The statistical analysis showed that there was no significant difference between and among all the three sites. Flowering and Fruiting is dependent upon the vegetative growth and on the availability and proper balance of mineral nutrients. More vegetative growth affects the reproductive growth of a plant. Our observations show a strongly negative correlation between vegetative growth and reproductive growth in *Cassiaobtusifolia*.

The number of seeds per fruit of Cassia obtusifolia is highest at site A 38.1±0.06 with one way ANOVA F ratio 19.9948Average seed output was 16305.78 at site B (highest)of *Cassia obtusifolia*and reproductive capacity of *Cassia obtusifolia* is highest at site B 3508.14 on the. All the three sites comes under Frequency class E.

Table-1: Showing Variation in Pigment Contents (mg/g fresh weight) in the Leaf of *Cassia obtusifolia* from all the Three Sites (values are mean of three replicates).

Sites	**Chlorophyll a (mean ± SD)**	**Chlorophyll b (mean ± SD)**	**Carotenoids (mean ± SD)**
A	0.85±0.03	0.32±0.07	1.13±0.062
B	0.78±0.01	0.51±0.005	0.99±0.035
C	0.75±0.04	0.26±0.037	0.66±0.028

NS=Not Significant *= Significant

Analysis of Variance: one way ANOVA

F-ratio: i. Chlorophyll a = 4.4673* ii. Chlorophyll b = 2.5989* iii. Carotenoids = 96.1165 ^{NS}

Table 2 Showing Variation in Agrobotanical Traits of *Cassia obtusifolia*from all the Three Sites (values are mean of 50 readings).

Parameters	Site A (mean±SD)	Site B (mean±SD)	Site C (mean±SD)
Plant Height(cm)	122±42.14	104.7±32.59	89.5±29.53
No. of Branches/Plant	19.70±2.41	21.01±2.05	18.02±2.46
No. of Leaves/Plant	1333.2±17.9	1357±24.90	1316.4±40.53
Leaf Area(mm)	205±38.01	186±38.78	190±36.87
No. of Fruits/Plant	125±15.79	139.6±10.36	134±15.46

NS= Not Significant *= Significant

Analysis of variance: one way ANOVA
F- ratio:i. Plant height =1.9242* ii. Branches /plant =1.6678*iii. Leaves/plant =1.9306*
iv. Leaf area =0.6287*v. Fruit/plant=1.0919*

Table 3 : Showing Variation in Seed Characters and Reproductive Capacity of *Cassia obtusifolia* from all the Three Sites (values are mean of 50 readings).

Parameters	Site A (mean±SD)	Site B (mean±SD)	Site C (mean±SD)
Seed Length(mm)	4.23±0.71	4.06±0.71	4.22±0.76
Seed Width(mm)	2.57±0.44	2.7±0.39	2.6±0.31
Number of Seeds/Fruit	38.1±0.60	35.9±2.84	30.36±1.03
Average Seed Output	15140.94	16305.78	15016.06
Seed Germination (%)	68	70	65
Reproductive Capacity	3238.1	3508.14	2644.3
Frequency Class	E	E	E

NS= Not significant * = Significant

Analysis of variance:
F- ratioi. Seed Length =0.1796* ii. Seed Width=0.3065*

: iiiNumber of Seeds/Fruit =19.9948^{NS} ivSeed Germination =10.9375^{NS}

Discussion and Result

Industrialization and Urbanization of cities especially metropolitan cities are facing fast growth in automobile number which is the major cause of dust pollution. These dust when blown carries with it large amount of pollutant into our houses and are cause of many air born diseases. Hence, covering the roadsides by vegetation is the need of hour. Keeping in view the persistent dust pollution caused by automobiles, to reduce it some field and laboratory experiments were conducted to study the reproductive and colonising capacity of *Cassia obtusifolia*

Pigment content-Plants during summers have to deal with soil water deficits, high temperature and high irradiance levels (Gonzalez *et al*., 2004). Furthermore, these plants have low tissue water potential because they are exposed to low temperature in winters (Gonzalez *et al*., 2000). In elevated radiation intensities, chlorophyll molecules are susceptible to photo-oxidation (Alvarenga*et al.*, 2003) hence, photosynthesis may be limited by temperature, stomatal control and light energy damage(Ottander*et al.*, 1995 and Castrillo*et al*., 2001).Resultsof the present study suggest that, even though, *Cassia obtusifolia* plant differed in pigment content and followed a seasonal pattern, during adequate or adverse conditions such as extreme temperatures and water shortages, they still could play important roles in maintaining the productivity of dry rangeland ecosystems.

Agrobotanical Traits -A careful study of data indicated that among Agrobotanical traits (Vadivel and Janardhanan, 2002 and Sridhar and Bhat, 2007) plant height in *Cassia obtusifolia*differed greatly among the three sites. As the reproductive capacity and survival of plants depends more on size rather than the age it is better to classify the life history of a plant by stages (size) rather than the age(Kirpatrick, 1984).Life history traits such as growth rate, reproductive capacity and phenotypic plasticity are all subject to selection pressure and are influenced by soil moisture and nutrients, herbivory, competition and pollutants etc.(Austrheim et. al 2005 Bradshaw,1965)

Seed Size and Seed Number- Seed size seems to be an important character in plant fitness. SSNT explaining the relation of seed size and seed number (Aiken and Springer., 1995). Both seed size and number are regarded as ecologically important life-history traits and provide increased fitness in various environments (Westoby*et al*., 1996).Bowers *et al*., (2004), explained that larger seeds have greater recruitment, greater percent germination or emergence success as compared to smaller seeds. Relatively low seed number was sufficient for maximal fruit set. Seeds are well known to be a rich source of plant growth regulators (Hedden and Hoad, 1985). These findings agree with our observations that in *Cassia obtusifolia*have low seed number hence the fruit set is high to very high.

Frequency- Mitchley and Grubb (1986) found positive correlation between seed size and abundance. This finding is similar to our observations that*Cassia obtusifolia* belong to Frequency Class 'E'. is the common and abundant plant and could be a good coloniser.
Reproductive Capacity-Reproductive capacity of a plant is another critical aspect of plant reproduction. According to Salisbury (1942) reproductive capacity of many plants is extremely great and there are large differences between species, these differences is due to selective pressures (Harper and White 1974)

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