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AUTECOLOGICAL STUDIES OF EXOTIC PLANT *HIBISCUS SABDARIFFA* L. (ROSELLE), A MULTIPURPOSE PLANT, FOR ITS INTRODUCTION AND CULTURE

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Hibiscus sabdariffa L. (Roselle) is a plant of economic importance. The data on all aspects of its autecology and culture have been reported and a method of its cultivation has been developed which gave good (per acre) yield. The seeds were found to be viable upto 85%. The optimum temperature range and photoexposure for germination were found to be 25-35°C and 12 hrs respectively. The crop needed irrigation twice in Karachi area climatic condition for the best growth. The viability of seeds collected from the harvested crop showed gradual decrease one year after collection and further on.

Key words: Autecology, Culture, *Hibiscus sabdariffa* L.

Introduction

Hibiscus sabdariffa L. (Roselle) belongs to the family Malvaceae and is distributed in temperate, tropical, subtropical and semi-arid zones. It is reported to be well adapted to any well drained fertile soil.

This plant has great nutritional and medicinal importance. [1-3]. Its calyces contain 6.7% protein by fresh weight and 7.9% by dry weight. Roselle also provides the national drink of Sudan (Karkadeh) [4]. Its flowers are reported to contain gossypetin, anthocyanin and glucoside hibiscin which have multiple physiological effects. Besides being diuretic, they are known to decrease the viscosity of blood, reduce blood pressure and stimulate the intestinal peristalsis [5]. The fruits are edible and the seeds are used as an aphrodisiac coffee substitute [6,7]. Dried fruits also contain vitamin C [8,9]. Roselle red obtained from the calyces may be used as a food dye [10].

Being a potential useful plant, experiments were conducted to cultivate this plant over an area of one acre for the first time in Karachi. The paper covers the data on its autecology and culturing method and steps for practical utilization of this useful plant.

Materials and Methods

Source of seeds. The seeds were imported from Agricultural Research Institute, Rajindar Nagar, Hyderabad Daccan, India.

Germination test. In the experiments, except where explained, the seeds were germinated in petridishes on filter papers moistened with water. Each experiment was repeated 5 times, before conclusions were drawn.

Effect of temperature. The seeds were kept in the germinating chamber for the treatment of seeds at low and high temperatures. Two parallel sets each of 100 seeds every time were taken and one of the sets was kept as control at 25°C.

Effect of duration of light or photoexposure. The seeds were daily subjected to a photoexposure of varying length under day light and were kept in darkness for the rest of the day, except for photoexposure longer than normal day length during the entire course of germination. When a longer photoexposure than the normal day length was required, a 100 W bulb was kept at a safe distance, to prevent any rise in temperature. During the dark period, the petridishes were covered with thick black light proof upper covers.

CULTURE EXPERIMENTS

Experimental conditions. All the culture experiments were conducted at experimental fields of PCSIR Labs. Complex, Karachi. The culture and harvesting methods for *H. sabdariffa* L. are similar to those for the closely related species *H. cannabinus* L. [11]. The seeds were sown in the begining of March and the crop was harvested towards the end of August. The minimum and maximum temperature(°C) with relative humidity (%) of desired months have been incorporated in Fig. 1.

Experimental beds. Beds of 6 x 6m were prepared, all the weeds removed and the soil thoroughly turned and mixed. Tenekil, a soil insecticide, produced locally was applied to protect the crop from the termites. Farmyard-manure was mixed with sand. After preparation of the beds, the pH was 7.5. The organic matter was found to be 46.5 mg/100g and exchangeable cations were 55.1 mequiv/100g soil. Nitrogen was estimated by semi-micro Kjeldhal's method and found to be 0.17%. The moisture was 8.01%.

Data collected on yield of crop were statistically analyzed by using analysis of variance technique and Latin design at 1% and 5% levels.

Effect of photoexposure. The beds were subjected to photoexposure alternating with dark periods during their entire life cycle. Sunlight was used as a normal source of light. But where the exposures, longer than day light were required, a 100W electric bulb was kept at a safe distance to avoid any rise in temperature.

Effect of irrigation. The plan of irrigation was observed daily, twice a week, weekly and fortnightly.

Effect of age of seeds on germination. One set of 100 seeds was observed for viability when freshly collected, and three sets of 100 seeds each were observed after being kept for 1,2 and 3 years respectively.

Collection and weighing of calyces. The fleshy calyces of *Hibiscus sabdariffa* L. were manually collected and dried in a temperature controlled oven at 40°C for 10 hrs. The dried calyces contained 83.36% moisture when weighed.

Results and Discussion

Seed germination. The seeds were germinated in the petridishes at room temperature (25°C). The percentage of germination has been shown in Fig. 2. It has been observed that only 85% seeds germinated, the rest being dead or immature. The seeds took 4-8 days for germination.

Effect of temperature on germination. Figure 2 shows that 85% seeds are viable and germination takes place in a narrow temperature range of 25-35°C. The rest of the seeds were sterile or immature. The germination decreased with a rise or a fall of the temperature. The lowest percentage of germination being at 15-20°C, the seeds did not germinate below 10°C and above 42°C. The seeds kept at 15-20°C started germinating on the 6th day, and 37°C on the 7th day (Table 1).

Effect of photoexposure on germination. Maximum number of seeds were germinated in a day light exposure of 12 hrs (Fig. 3). The rate of germination falls to 48% at 6 hrs exposure and to 32% at 18hrs exposure. Only few seeds germinated in total darkness and died within a day or two.

Effect of photoexposure on the growth of plants. The optimum growth of the plants were observed from seeds exposed to 12 hrs light a day. Decrease of exposure by 6 hrs had the worst effect.The plants were weak, with short internodes

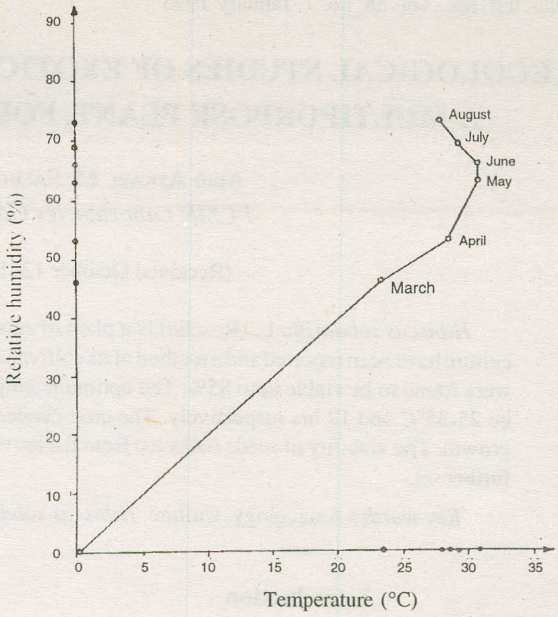

Fig. 1. Showing temperature and humidity % in the months (March-August).

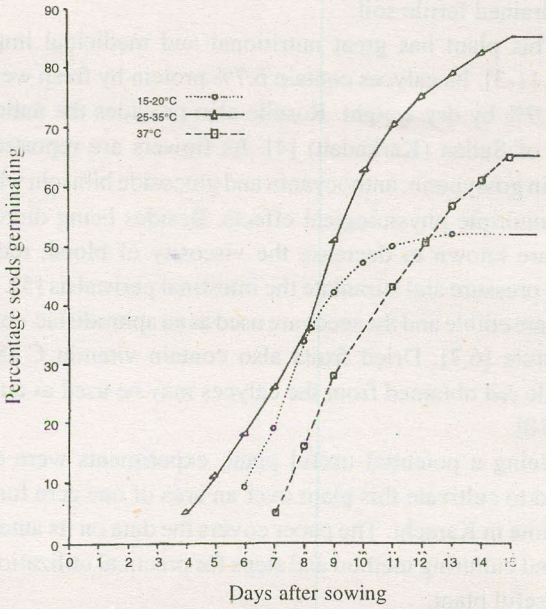

Fig. 2. Effect of temperature on germination

TABLE 1. EFFECT OF TEMPERATURE ON GERMINATION OF *HIBISCUS SABDARIFFA* L.

Sr. No.	Treatment °C	Total % Germination	Percentage of seeds germinating on various days (Number of days after setting)																	
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1.	10° (constant)	0	No germination																		
2.	15-20°	52	"	"	"	"	"	9	10	15	8	5	3	1	1	"	"	"	"	"	"
3.	25-35°	85	"	"	"	5	6	7	8	10	15	12	7	5	4	1	2	1	1	"	"
4.	37° (constant)	65	"	"	"	"	"	"	7	9	12	15	"	8	6	4	3	"	1	"	"
5.	42° " "	0	No germination																		

TABLE 2. EFFECT OF PHOTOEXPOSURE ON GROWTH OF THE PLANTS.

Duration of exposure (hr)	Height of plant (cm)	Minimum length of internode (cm)	Maximum length of internode (cm)	Mean (cm)	Date of flowering	Minimum numbers of flowers/ plant	Maximum numbers of flowers/ plant	Mean (cm)
6	60	4.0	5.5	4.7±0.53	15.8.90	8	12	10±1.41
12	145.0	7.0	8.0	7.5±0.35	25.7.90	28	38	33±3.53
18	120.0	6.0	7.0	6.5±0.35	5.8.90	15	20	17±1.76
24	70.0	5.0	6.0	5.5±0.35	8.8.90	10	18	14±2.82

Means are followed by ± S.E.

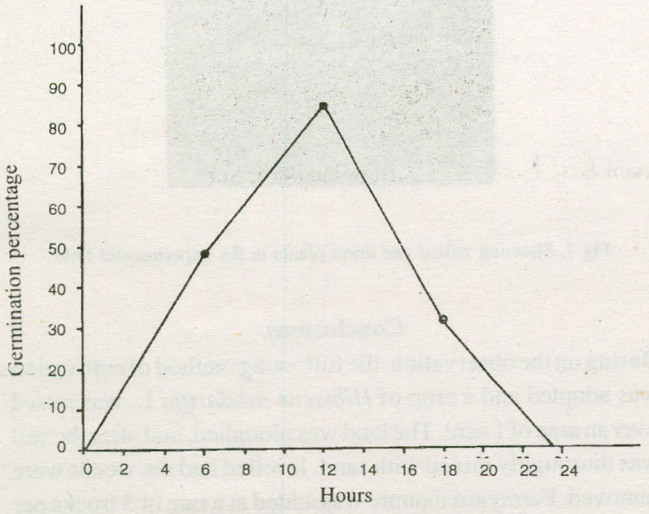

Fig. 3. Effect of photoexposure on germination.

TABLE 3. EFFECT OF IRRIGATION ON CROP.

Irrigation period	Height of plant (cm)	Minimum no. of flowers/ plant	Maximum no. of flowers/ plant	Mean
Daily	95.0	9	12	10 ±1.06
Twice a week	145.0	28	38	33±3.53
Weekly	125.0	20	25	22±1.76
Fortnightly	83.0	12	15	13±1.06

Means are followed by ± S.E.

and very late flowering and bore 1/4 of the number of flowers as compared to 12 hrs. On the other set of experiments the shorter and longer daylength gave poorer growth (Table 2 and Fig. 4 A&B).

Effect of irrigation. Irrigation of any plantation largely depends on climatic conditions i.e. temperature, humidity, wind speed and also on soil moisture. During the months Mar. to Aug., considering Karachi climate condition, the optimum irrigation schedule was found to be twice a week. The average height of the plants in the experimental beds were upto 1.45cm, each plant bearing an average number of 33 flowers (Table 3 and Fig. 5). As a result of daily watering, the plants started wilting in the experimental field in the initial stage and

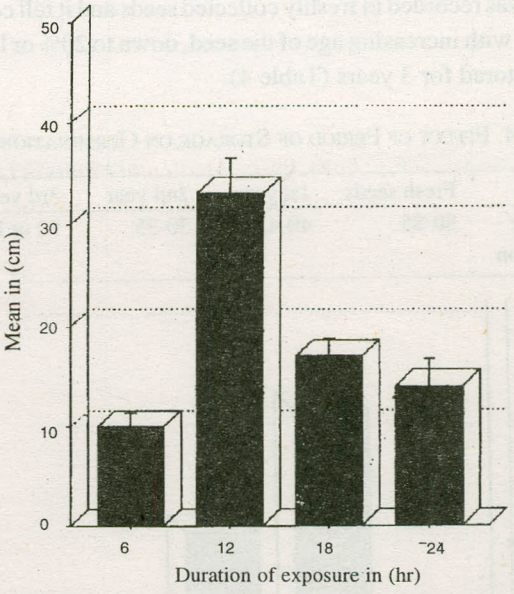

Fig 4A. The effect of photoexposure on growth of the plants showing the number of flowers/plant.

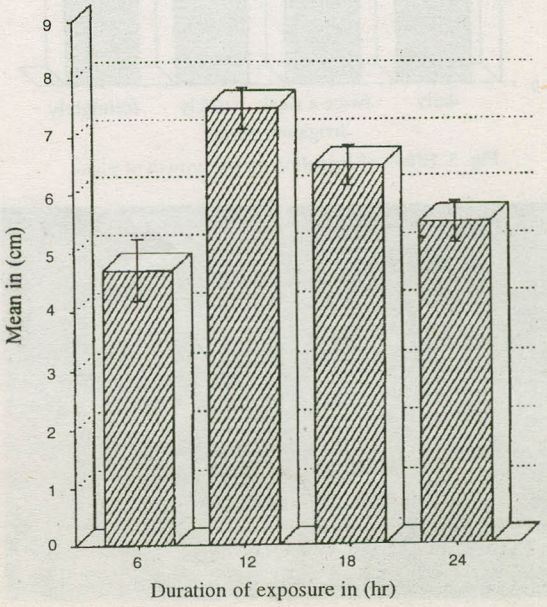

Fig 4B. The effect of photoexposure on growth of the plants showing length of internode.

then drooped. Such plants eventually died prematurely and it was diagnosed to be due to fungal root-rot (Fig. 6 and 7). Due to the losses of these newly introduced plants, it was considered worthwhile to examine the infected material. The pathogen was identified as *Fusarium solanii* (Mart) Saec. Benlate was sprayed at the rate of 20 ppm and was effective for the control of root-rot caused by strain of *F. solanii*. The weekly and fortnightly irrigation gave no better results as compared to twice a week.

Effect of age of seeds on germination. A germination rate 80-85% was recorded in freshly collected seeds and it fell continuously with increasing age of the seed, down to 20% or less in seeds stored for 3 years (Table 4).

TABLE 4. EFFECT OF PERIOD OF STORAGE ON GERMINATION.

	Fresh seeds	1st year	2nd year	3rd year
Percentage Germination	80-85	40-45	30-35	20 or less

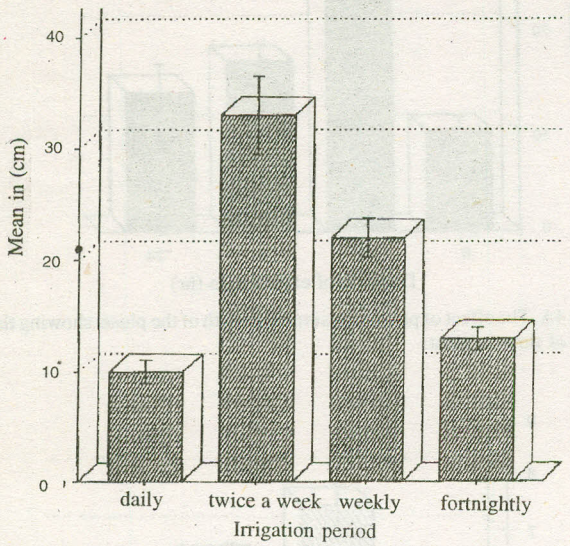

Fig. 5. Effect of irrigation on the growth of plants.

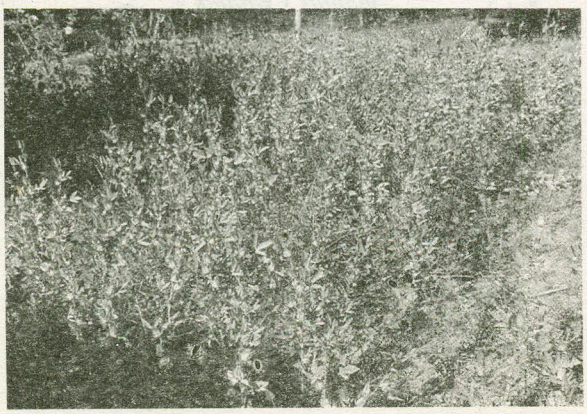

Fig. 6. *Hibiscus sabdariffa* L. growing in the experimental field of PCSIR Laboratories Complex, Karachi.

Fig 7. Showing wilted and dried plants in the experimental field.

Conclusions

Basing on the observation, the following method of cultivation was adopted and a crop of *Hibiscus sabdariffa* L. was raised over an area of 1 acre. The land was ploughed, and after the soil was thoroughly mixed with sand, levelled and the weeds were removed. Farmyard manure was added at a rate of 5 trucks per acre. About 3.6 kg seeds collected from the previous crop were sown and beds were irrigated. The seeds were found to germinate upto 85% in 2 weeks. When the seedlings attained a height of 15cm they were thinned out where necessary to keep them at a distance of 45-60cm. They were irrigated according to plan. When the plants attained a height of 45cm, the field was weeded and superphosphate at the rate of 1 1/2 bag (75 kg) per acre was sprinkled. The crop flowered in the 3rd week of Jul. and fruits ripened in the end of Aug. The calyces were collected and dried. One acre of *Hibiscus sabdariffa* L. crop yielded 250 kg of fresh calyces. Thedry calyces weighed 41.6 kg from which 680 bottles of refreshing herbal beverage could be made and commercialized.

After harvesting flowers and fruits the stumps of crop were chemically analysed to evaluate its suitability as a possible/alternate source of pulping material for making paper. The results were quite encouraging and showed that its α–cellulose content had a range of 56.2 to 57.8% which is a maj or constituent of paper. The bleached pulp of Roselle was found to be very good quality and could be used in the pulp and paper industry [12, 13]. The lignin component was also on the lower side (9.8-10.1%) in stump which goes in its favour for pulping material for paper making.

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