STUDIES ON THE AUTECOLOGY AND CULTURE OF LALLEMENTIA ROYLEANA BENTH.

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Lallementia royleana Benth. is found growing wild in West Pakistan. The seeds of the species are used medicinally and are comparable with the seeds of *Plantago ovata*. As the yield per acre of *L. royleana* and mucilage contents of the seeds are larger than the different species of *Plantago*, experiments on its culture were undertaken further to improve the quality of drug. Observations on its culture and autecology have been given and a method of its cultivation has been developed which improved the quality and yield per acre of the drug considerably.

Introduction

Lallementia royleana Benth. belongs to the family Labiatae and is distributed in Afghanistan, Iran and Turkey.[1,2] Being fairly indigenous to West Pakistan, it is found scattered in the areas of the former N.W.F.P., Punjab, Sind and Baluchistan. The plant is associated with *Fagonia cretica*, *Peganum harmala*, *Polygonum plebijum* and *Rumex dentatus*. The plant prefers semi-arid climate where the water is not in abundance and the soil is sandy. It is cultivated on a small scale in Punjab.[2] The seeds are known in vernacular as "Tokhem-e-balanga", and are of black colour. In the indigenous system of medicine, it is given internally as diuretic and soothing drink in urinary troubles.[3] The action of the drug is purely mechanical, which is due to large amount of mucilage contained in the seeds. The mucilage does not affect the digestive enzymes and passes unchanged through the small intestine like *plantago* seeds. Locally it is applied on boils and abscesses.[3,4] Very little is known about the chemistry of Lallementia seeds. The preliminary chemical analysis of the seeds carried out at these laboratories, has shown that the mucilage of Lallementia seeds resemble very closely to the mucilage of seeds of *Plantago major* Linn. and *Plantago ovata* Forsk. It can, therefore, be substituted safely for the mucilage obtained from *Plantago* seeds. It contains rhamnose and arabinose as in *P. ovata* Forsk. and *P. major* Linn., glucose as in *P. major* Linn., and xylose with an unknown sugar as in other *Plantago* species.

As the yield per acre of *Lallementia royleana* Benth. and the mucilage contents of the seeds is larger than the different species of *Plantago* put together, it was considered worthwhile to study its autecology and culture which would help in the production of seeds on a commercial scale.

Methods and Materials

Source of Seeds.—Plants were grown from the seeds of a single plant collected from the suburbs of Nowshera.

Germination Test.—In the experiments, except where explained, the seeds were germinated in petri dishes 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 20°C.

Effect of the Duration of Light or Photoexposure.—The seeds were daily subjected to photoexposure, alternating with dark period during the entire course of germination. Sunlight was used as a source of light, but when a longer photoexposure than the normal day length was required, a 100 W electric bulb was kept at a safe distance, to prevent rise in temperature. During the dark period, the petri dishes were covered with thick black, light-proof covers.

Culture Experiments

Experimental Conditions.—All the experiments were undertaken at the experimental farm of these laboratories (1180 ft above sea level). The seeds were sown in the beginning of February and the crops harvested towards the end of April. The temperature ranged from 49.6°F, to 69.9°F in February; from 51.6°F to 73.0°F in March and from 58.6°F to 80.7°F in April, respectively.

Experimental Beds.—Small beds of 3′×3′ were made, all the weeds removed and the soil thoroughly turned and mixed. The soil of the controlled beds were loamy, having a pH 7.8. The organic matter was found to be 47.7 mg/100 g and the exchangeable cations were 56.1 mequiv/100 g soil. Nitrogen was estimated by Kjeldahl's method and found to be 0.17%. The moisture was 11.01%.

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 exposures, longer than the day light, were required, a 100W

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electric bulb was kept at a safe distance to avoid rise in temperatures.

Effect of Irrigation.—The plan of irrigation was observed daily, twice a week, weekly (control experiments) and fortnightly, at the rate of half shower can per bed. The beds were kept covered during the rains for avoiding excessive watering.

Effect of Soil Texture.—The soil of the experimental beds were dug up to 1 ft deep and filled with different compositions of soil and sand. The rest of the conditions remained identical to the controlled bed.

Effect of Manure.—The beds were treated with different quantities of manures and fertilizers. All other conditions remained similar to those of the control soil.

Measurement and Weighing of Seeds.—The seeds of *Lallementia royleana* Benth. were dried in a temperature-controlled oven at 60°C for 10 hr. The dried seeds containing 5% moisture were then measured and weighed.

Observations

Seed Germination.—The seeds were germinated in petri dishes at room temperature (20°C). The rate and percentage of germination has been shown in Fig. 1. It has been observed that only 70% seed germinated, the rest being dead or immature. The seeds take 3–10 days for germination.

Effect of Temperature on Germination.—Figure 1 shows that 70% of the seeds are viable at 20°C which is the optimum temperature. The rest of the seeds were sterile or immature. The rate of germination decreased with the rise or fall of the temperature. The lowest percentage of germination being at 35°C, the seeds did not germinate below 15°C. The seeds kept at 20°C started germinating on the 5th day, at 25°C on 8th day and at 35°C on 13th day.

Effect of Photoexposure on Germination.—Maximum number of seeds were germinated in the daylight exposure of 12 hr (Fig. 2). The rate of germination falls to 47% at 6 hr exposure and to 35% at 18 hr 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 plant was observed in the experiments exposed to 12 hr light (Table 1).

Decrease of the exposure by 6 hr had the worst effect. The plants were weak, with short internodes, very late in flowering and bore 1/10th of the number of seeds as compared to the control plants. On the other hand, the plants exposed to 24 hr light were feeble, more or less prostrate, with long stems and long internodes. Their flowering was also late and the seed production was very low. In all, the set of experiments exposed to 12 hr gave the best results. Short and long exposures adversely affected the root and shoot ratio also.

Effect of Irrigation.—Irrigation of any plantation largely depends on the climatic conditions of the environment, i.e. temperature, humidity, velocity of the air and water contents. During the months February to April, considering the local conditions, it has been observed that irrigation of plantations once a week did produce results. The average height of the plants in the experimental beds were upto 45 cm, each plant bearing an average number of 1121 seeds.

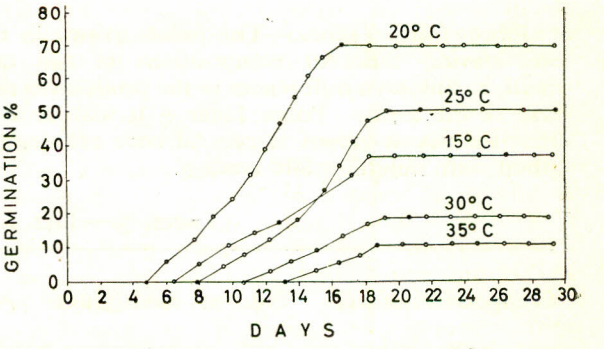

Fig. 1.—Showing the effect of temperature on germination.

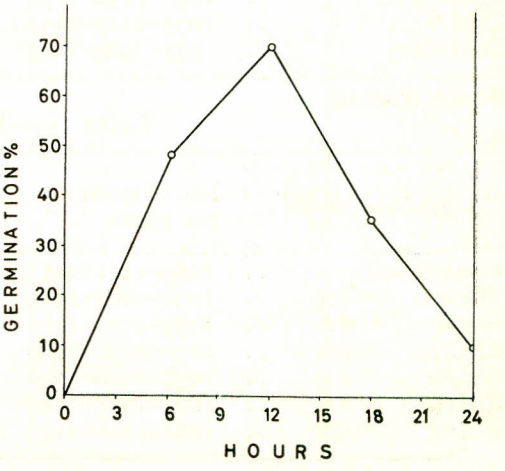

Fig. 2.—Showing the effect of photoexposure on germination.

TABLE 1.—THE EFFECT OF PHOTOEXPOSURE ON THE GROWTH OF PLANTS.

Duration of exposure hr	Height of plant in cm	Average length of internodes in cm	Date of flowering	Root/shoot ratio	No. of seeds/plant
6	20.5	4.0–4.2–5.1	12-4-66	0.92	104–120–144
12	45.0	5.5–5.8–6.0	26-3-66	1.03	1083–1121–1155
18	50.0	4.5–4.7–5.2	22-3-66	1.17	170–196–220
24	60.0	6.0–6.3–6.9	15-3-66	0.87	156–170–200

TABLE 2.—THE EFFECT OF IRRIGATION ON THE CROP.

Irrigation period	Height of plants in cm	No. of seeds/plant	No. of seeds/g
Daily	25.5	180–192–200	517
Twice a week	40.7	210–226–240	918
Weekly	45.0	1083–1121–1155	888
Fortnightly	29.0	75–89–95	663

Effect of Soil Texture.—The plants grown in the soil having different compositions of soil and sand, have shown differences in the production and size of the seeds. From Table 3 it will be seen that the plants grown as control bore 1121 seeds/plant and weighing 888 seeds/g.

Effect of Manure.—Addition of manure affected the production per plant, and their size.

The addition of 10% cowdung or leafmold increased the number of seeds per plant from 1121 to 1156 and 1140 (Table 4). The size of the seed has also been affected. The seeds from the control were 3.10×1.07 mm, weighing 888 seeds per g. In both kinds of manure, the cowdung has given better results. It will be noted that the addition of more than 10% manure adversely affects the size of the seeds which tends to decrease the number of seeds per g as well as the number of seeds per plant.

Effect of Fertilizer.—Table 5 shows that the addition of 2% superphosphate gave optimum results. The addition of superphosphate up to 6% increased the number of seeds per plant as compared to the control but less as compared to 2% and the size of the seeds reduced considerably.

TABLE 3.—THE EFFECT OF SOIL TEXTURE.

Composition of soil	No. of seeds/plant	Average size of seeds in mm		No. of seeds/g
		Length	Breadth	
Control soil ..	1083–1121–1155	3.00–3.10–3.20	1.01–1.07–1.13	888
Pure sand ..	1062–1095–1130	3.04–3.08–3.10	1.00–1.04–1.08	915
Sl:Sd=3:1 ..	1090–1130–1172	3.09–3.13–3.17	0.92–1.09–1.18	860
Sl:Sd=1:1 ..	1075–1115–1150	3.00–3.07–3.14	1.01–1.03–1.07	905
Sl:Sd=1:3 ..	941– 984–1024	3.00–3.03–3.09	0.80–0.98–1.20	872

Sl=Soil; Sd=Sand

TABLE 4.—THE EFFECT OF MANURE.

Composition of soil	No. of seeds per plant	Average size of seeds in mm		No. of seeds/g
		Length	Breadth	
Control soil ..	1083–1121–1155	3.00–3.10–3.20	1.01–1.07–1.13	888
Sl:Cd =1:9 ..	1051–1084–1115	3.00–3.08–3.16	0.96–1.07–1.14	871
Sl:Cd =8:2 ..	1095–1141–1165	3.00–3.16–3.28	0.80–0.93–1.12	843
Sl:Cd =9:1 ..	1120–1156–1188	3.16–3.23–3.30	0.92-1.09–1.19	840
Sl:Lm =1:9 ..	1037–1068–1098	3.12–3.24–3.32	0.84–0.98–1.08	755
Sl:Lm =8:2 ..	1021–1074–1123	3.10–3.15–3.30	0.88–1.06–1.18	816
Sl:Lm =9:1 ..	1081–1140–1175	3.18–3.28–3.34	0.80–1.02–1.08	860

S=Soil; Cd=Cowdung; Lm=leafmold.

TABLE 5.—THE EFFECT OF FERTILIZER.

Composition of soil	No. of seeds per plant	Average size of seeds in mm		No. of seeds/g
		Length	Breadth	
Control soil ..	1083–1121–1155	3.00–3.10–3.20	1.01–1.07–1.13	888
Sl:Sp =94:6 ..	1091–1142–1185	2.95–3.18–3.41	0.80–0.96–1.20	817
Sl:Sp =94:4 ..	1107–1153–1190	3.00–3.20–3.40	0.78–0.95.1.18	889
Sl:Sp =98:2 ..	1141–1184–1200	2.90–3.23–3.38	0.88–1.09–1.16	772

Sl=Soil; Sp=Superphosphate.

Conclusions

Keeping in view the observations, the following method of cultivation was adopted and a crop of *Lallemantia royleana* Benth. was raised over an area of 1 acre.

The land was ploughed, thoroughly mixed with sand (in the case of hard soil), levelled and the weeds were removed, cowdung manure at the rate of 5 trucks per acre was added. About 3 lb seeds, collected from the previous crop, were broadcast and the plot was irrigated. The seeds were found to germinate completely in a week. When the seedlings attained a height of 3–4 in they were thinned out where necessary to keep them at a distance of 8–10 in. The crops were liberally irrigated in the first month, then twice and once a month respectively. When the plants were about 20–25 cm high, the field was weeded and the superphosphate at the rate of 1½ bag per acre was sprinkled. The crop flowered in the first week of April and the fruits ripened at the end of April. The fruits were collected before dispersal of seeds, and were dried in the sun for 3–4 days. The seeds were separated by winnowing and thrashing. One acre of *Lallementia* crop yielded 3 maunds of seeds. The cost of raising the crop of Lallementia at Peshawar came to Rs. 75.00 per acre, excluding the rent of the land.

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