SOME FACTORS AFFECTING THE SEED PRODUCTION IN PLANTAGO PSYLLIUM CROP

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Plantago psyllium Linn. growing wild in West Pakistan, was cultivated. Effects of soil pH, texture, manure and fertilizers on the production of psyllium seeds have been discussed. It has been observed that by adopting suitable methods, the crops of *P. psyllium*, Linn. could be raised, profitably, for commercial exploitation in West Pakistan.

The genus *Plantago* belongs to family *Plantaginaceae* and includes about 200 species of which *P. psyllium* Linn., *P. ovata* Forsk. *P. major* Linn., *P. lanceolata* Linn., and *P. ciliata* Desf. are found in West Pakistan.[2] *P. psyllium* Linn. originally a native of the Mediterranean grows, in a scattered state, along water channels in the North-Western part of West Pakistan.

The seeds of *P. psyllium* Linn., commercially known as 'psyllium seed', or 'plantain seed' are used as a drug. The husk of the seeds is reputed to have cathartic properties.[3, 4] These properties are due to the swelling of the mucilagenous seed coat, which brings about lubrication. The mucilagenous layer of the seed coat known as 'psyllium seeds husk', is mixed with various chemicals such as powdered anhydrous dextrose, sodium bicarbonate, monobasic potassium phosphate and citric acid, and is used as an adjunct in the treatment of constipation.[4]

The entire pysllium supplies in the world market are met by France, where it is cultivated on a very extensive scale. The U. S. A. is the major importer.

In view of the fact that all preparations of psyllium seeds are imported in the country at the cost of valuable foreign exchange, experiments on its cultivation and application of manure and fertilizers to the crops have been undertaken at the Experimental Farm of these Laboratories.

Materials and Methods

Seeds.—Seeds collected from wild plants, growing along the water channels at the Peshawar University Campus were, sown in a small bed at the Experimental Farm. From this crop uniform plants were selected for the collection of seeds which were later on used in the experimments and had the following description. The colour of the seeds was brown, length 2.56 mm, breadth 0.95 mm, weight 0.0769 g per 100 seeds, and a swelling factor of 12.3.

Germination Test.—One hundred seeds were sown in each petri dish on moist blotting paper and a set of 3 dishes were kept separately in the germinating chamber at 15°, 20°, 25° and 30°C. The average viability percentage and the rate of germination was noted.

Cultural Experiments.—About 150 beds, of $6' \times 3'$ size, with uniform soil composition, were prepared. Different percentages of sand, manure and fertilizers were added to a set of 3 beds. Watering, hoeing and weeding of all the beds were kept unifrom throughout the experimentation. The seeds were sown on the 3rd February, when the dew is heavy, and the crop was harvested on the 21st May. Watering of the experimental beds was carried out as and when required, with an average of once a fornight to twice a week.

Observations on the plants growing in each set of experimental beds were recorded and averages were calculated. Swelling factor of the seeds were determined according to Youngken.[5]

Control Soil.—All the experimental beds were dug out about 2 ft deep, the soil was mixed and sifted thoroughly after removing the weeds. The control soil showed the following results on analysis: pH 7.7, inorganic matter 5.4 mg/g, nitrogen 4.5 mg/g, structure loamy.

Observation and Discussion

Viability of Seeds.—The seeds were sown on the 9th February 1966 and the experiments of germination were completed on the 29th February 1966. There was no germination at 15°, 25°, and 30°C. The seeds in the dishes at 20°C started germinating on the 13th Feburary 1966. The number of seeds germinating during the 1st.

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TABLE 1.—EFFECT OF pH OF THE SOIL.

Expt. No.	pH of the soil	Date of flowering	No. of seeds plants	Average size in mm		Swelling factor
				Length	Breadth	
1	7.0	15.3.66	138	2-2.45-2.72	0.8-1.03-1.08	8.4
2	7.2	17.3.66	145	2.08.2.56-2.88	0.8-0.97-1.04	11.2
3	7.4	23.3.66	195	1.5-1.88-2.6	0.64-0.7-0.72	12.1
4	7.5	23.3.66	252	1.92-2.32-2.76	0.8-0.96-1.2	12.0
5	7.7	29.3.66	259	2-2.56-2.92	0.84-0.95-1.04	12.3
6	7.8	27.3.66	290	1.76-2.34-2.56	0.84-0.96-1.04	14.5
7	8.1	2.4.66	361	1.7-2.5-2.21	0.88-0.99-1.02	16.9
8	8.3	4.4.66	384	2.04-2.7-3.08	0.76-1.03-1.12	17.8
9	8.4	5.4.66	315	2.1-2.55-2.9	0.79-0.94-1.1	17.9
10	8.5	5.4.66	282	2.5-2.8-2.9	0.92-0.99-1.04	17.1
11	8.7	5.4.66	165	2.44-2.68-2.84	0.96-1.05-1.12	16.7
12	8.9	7.4.66	104	2.3-2.6-2.7	0.91-.1.1-1.3	16.2

2nd and 3rd week was 9, 12, 44 respectively, thus showing an average of 65% of viable seeds.

pH of the Soil.—To the control soil with a pH of 7.7, suitable quantities of sulphuric acid and lime were added for altering the pH of the soil from neutral to 8.9. The plants grown in the beds having different pH values of soil showed the following variations in their growth characters.

Table 1 shows that the pH value of the soil affects the flowering period, the number of seeds per plant, their size and the swelling factor. It will be seen that the pH value of the soil affects the period of flowering. Whereas the plants grown with 7.0 pH value of the soil started flowering on March 15, 1966, the flowering of the plants grown in the soil of 8.9 value was delayed by 22 days. Similarly, the pH value of the soil affected the S. F. of the seeds. In neutral soil, the S. F. was 8.4. It was noted that as the pH value increased the S. F. also increased simultaneously upto the pH value of 8.3 (Expt. No. 1–8). Subsequently, when the pH value was further increased it adversely affected the S. F. Thus, the plants growing on the soil of pH values ranging from 8. 1–8.3 yield the maximum number of seeds with the maximum S. F.

It has been observed that in most of the experiments (except Expt. No. 9)* the number of seeds per plant is directly correlated with the swelling factor. The pH value of the soil seemed to have no effect on the size of the seed.

Effect of Soil Texture.—Coarse sand was mixed with the control loamy soil in different proportions in a number of beds and the following observations were recorded.

Table 2 shows that the texture of soil has considerable effect on the number of seeds per plant and their size. The number of seeds per plant was maximum when the soil and sand were in equal proportions. There seemed to be no direct correlation between the texture of soil and the size of the seeds. In the composition of 1 : 1 the seeds were quite large though not as large as in composition of 1:4, which bore even half of the number of seeds as compared to 1 : 1 composition.

* This may be due to some error in setting the experiment or taking observation.

Effect of Manure.—Different proportions of leaf mould and cowdung manure were added to the soil. The observations on the seed production and swelling factors are given in Table 3.

No definite conclusion can be drawn from the above experiments. It will however be observed that in expt. Nos. 22, 27 and 28 the composition of soil and leaf mould, and soil and cowdung is 8:2, 8:2 and 7:3, respectively; the swelling factor having been increased to 17.5. On the other hand, the number of seeds has been considerably reduced, from 176 (control) to 96, 97 and 90.

Effect of Fertilizers.—Different percentage of superphosphate was added to the control soil and the observations noted in Table 4, Experi-

TABLE 2.—THE EFFECT OF SOIL TEXTURE.

Expt. No.	Composition of soil	No. of seed/plant	Average size of seeds in m.m.	
			Length	Breadth
13	Control soil	176-259-420	2-2.56-2.92	0.84-0.95-1.04
14	Sl:Sd = 4:1	124-138-152	1.76-2.34-2.56	0.84-0.96-1.04
15	Sl:Sd = 3:2	127-240-354	1.7-2.5-2.21	0.88-0.99-1.02
16	Sl:Sd = 1:1	352-528-707	2.04-2.7-3.08	0.76-1.03-1.12
17	Sl:Sd = 2:3	202-358-514	2.01-2.55-2.9	0.79-0.94-1.1
18	Sl:Sd = 1:4	104-221-440	2.6-2.8-2.9	0.92-0.89-1.04
19	Pure sand	104-131-168	2.44-2.68-2.84	0.96-1.05-1.12

Sl, soil; Sd. sand.

TABLE 3.—THE EFFECT OF MANURE.

Expt. No.	Composition of soil	No. of seeds	Average size of seed in m.m.		Swelling factor
			Length	Breadth	
20	Control soil	176-259-420	2-2.56-2.92	0.84-0.95-1.04	12.3
21	Sl:Lm = 9:1	156-198-280	2.1-2.58-2.8	0.81-0.9-1.00	15.4
22	Sl:Lm = 8:2	96-80-160	1.9-2.6-2.78	0.86-0.96-0.99	17.5
23	Sl:Lm = 7:3	80-63-140	2-2.59-2.9	0.8-0.91-0.97	14.3
24	Sl:Lm = 6:4	68-58-90	1.9-2.53-2.8	0.83-0.97-0.99	14.5
25	Sl:Lm = 5:5	60-79-96	1.87-2.47-2.6	0.78-0.9-0.93	13.2
26	Sl:Lm = 9:1	84-105-130	1.9-2.53-2.9	0.8-0.92-0.96	14.0
27	Sl:Cd = 8:2	97-150-170	2.2-2.61-3.01	0.91-.1.02-1.1	17.5
28	Sl:Cd = 7:3	90-149-160	2.5-2.7-3.2	1.0-1.2-1.3	17.5
29	Sl:Cd = 6:4	180-215-240	2.4-2.64-3.00	0.92-1-1.2	15.4
30	Sl:Cd = 5:5	200-293-310	2-2.5-2.8	0.8-0.84-1.0	13.2

Cd, cowdung; Lm, Leafmould; Sl, soil.

TABLE 4.—THE EFFECT OF SUPERPHOSPHATE.

Expt. No.	Composition of soil	No. of seeds/ plant	Average size of seeds in mm.		Swelling factor
			Length	Breadth	
31	Control soil	176-259-420	2-2.56-2.92	0.84-0.95-.1.04	12.3
32	Sl:Sp = 99:1	160-229-365	1.7-2.3-2.5	0.76-0.9-1.00	16.0
33	Sl:Sp = 98:2	210-285-310	1.78-2.33-2.4	0.8-0.92-1.02	17.0
34	Sl:Sp = 97:3	280-309-340	1.64-2.32-2.5	0.9-0.99-1.1	16.0
35	Sl:Sp = 96:4	219-256-276	1.9-2.3-2.6	0.8-0.96-1.2	15.6
36	Sl:Sp = 95:5	188-216-240	2.1-2.39-2.6	0.96-0.98-1.1	15.5
37	Sl:Sp = 93:7	170-215-250	2.01-2.45-2.7	0.78-1-1.2	14.3
38	Sl:Sp = 90:10	190-204-225	2.0-2.45-2.58	0.87-1.01-1.1	14.0

Sl, Soil; Sp, superphosphate.

ments with ammonium sulphate and urea were a total failure.

Superphosphate in a concentration of 2% gives the maximum swelling factor and with 3% gives the maximum number of seeds. It has also been observed that further addition of superphosphate hardens the upper layer of the soil.

Conclusions

Plantago psyllium L. is a plant of alkaline soil with an optimum pH of 8.3 and produces best results with a well-drained soil of the composition of 1 part loamy soil and 1 part coarse sand. An addition of 2–3% superphosphate further increases the number of the seeds and the quantity of the mucilage contents. Keeping in view all the above points, a crop of *P. psyllium* L. was raised at 1/8 of an acre plot by broadcasting the seeds and later on thinning the seedlings where necessary. 0.5 kg of seeds are sufficient to raise a crop on 1 acre. The seeds were collected just before ripening and dried in the sun. The yield was 130 kg seeds/acre. The seeds had the following specifications as compared to the seeds from wild plants.

	Wild plant	Cultivated plant
Number of seeds/plant	176-239-420	352-528-707
Length nf seed (in mm)	2-2.56-2.92	2.04-2.7-3.08
Breadth of seed (in mm)	0.84-0.95-1.04	0.76-1.03-1.12
Swelling factor	12.3	17.8

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