

## CULTIVATION OF WINGED BEAN (*PSOPHOCARPUS TETRAGONOLOBUS* (L. DC.) AT LATITUDE 25° – 54' NORTH, KARACHI, PAKISTAN

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Successful cultivation experiments on the winged bean, *Psophocarpus tetragonolobus* (L. DC.), were conducted at latitude 25°–54', North, Karachi, Pakistan, for the first time, although efforts were also made by others to grow it at latitude 31° North Faisalabad, as well as at Islamabad, but the results were not encouraging and in very few cases was the pod formation was achieved. The detailed results of our experiments have been provided and different factors operative in the successful cultivation of the winged bean have been discussed. Based on our experience, certain broad conclusions have also been drawn.

### INTRODUCTION

The winged bean, *Psophocarpus tetragonolobus* (L.) DC., is a newly introduced plant of considerable significance in different parts of the world. Initially it was rather less known and restricted to South East Asia and Pacific [1, 2, 3], where it has long been cultivated. However, during the last 12 years or so it has received worldwide attention mainly due to its nutritive value. National Academy of Sciences, USA, recognised the merits of this plant and included it in the list of underexploited tropical plants of promising value [4]. Recently the merits of this plant, which includes its nodulation capacity, multiple uses and high protein contents [5, 6] have been widely appreciated. Nutritionists expect this leguminous plant to play an important role in coping with food shortages and protein requirements throughout humid tropics. All parts of this plant are edible. The green pods, leaves, seeds and tuberous roots are rich in protein, minerals and vitamins (Table 1-2). The protein value of its seeds is close to that of soybean with similar amino acid composition (Table 3). The seeds are also a source of edible oil (15-20%) with fatty acids

comparable with soybean (Table 4). The mature seeds are not eaten raw and require cooking for 2-3 hr. Different preparations could be made from the seeds as well; they could be used for making bean milk and roasted and eaten like peanuts [7]. The bean milk is known for the successful treatment of Kwashiokor cases in Ghana [8, 9]. The tuberous roots of the winged bean could be utilized like potatoes and the leaves and flowers used for the preparation of salads or could be consumed raw.

In Papua New Guinea, Burma, Thailand, Malaysia, Philippines, Vietnam and some other countries of S.E. Asia, the winged bean has been accepted as food without any known deleterious effects from its consumption [6].

Preliminary efforts to introduce winged bean in Pakistan were made at Faisalabad and Karachi but did not succeed [10]. Experiments conducted by us on TP<sub>1</sub> and TP<sub>2</sub> varieties succeeded and were rather encouraging. As a result, profuse fruiting took place and mature viable seeds were procured.

Table 1. Proximate composition of different parts of the winged bean. Values recorded are mg/100 g fresh weight; (data taken from the booklet on winged bean, published by National Academy of Sciences, USA, 1975)

	Immature pods	Seeds	Tubers	Leaves	Flowers
Water	76-92	6.7-24.6	54.9-65.2	64.2-77.2	84.2
Protein	1.9-2.9	29.8-37.4	12.2-15.0	5.7-15	5.6
Fat	0.2-0.3	15.0-20.4	0.5-1.1	0.7-1.1	0.9
Carbohydrates	3.1-3.8	28.0-31.6	27.2	—	—
Fiber	1.2-2.6	5.0-12.5	17.0	—	—
Ash	0.4-1.9	3.6-4.0	0.9	—	—



Table 2. Contents of minerals and vitamins in different parts of the winged bean (the values are expressed as mg/100 g fresh weight; data taken from the booklet on winged bean, published by the National Academy of Sciences, USA, 1975

Component	Immature pod	Seed	Tuber
<b>Minerals</b>			
Calcium	63-330	204-370	40
Magnesium	—	120-204	—
Potassium	—	110-120	—
Sodium	—	20-56	—
Phosphorus	60	276-320	64
Iron	1.3-1.7	9.6-11.8	3.0
<b>Vitamins</b>			
$\beta$ -carotene	0.54	—	—
Tocopherols	—	1.26	—
Thiamin	0.06	1.4	—
Riboflavin	0.12	0.2	—
Niacin	0.5	—	—
Ascorbic acid	22.37	—	—

#### MATERIALS AND METHODS

Seeds of TP<sub>1</sub> and TP<sub>2</sub> varieties of the winged bean were procured in very small quantities from the International Institute of Agriculture, Ibadan, Nigeria. Since TP<sub>1</sub> seeds were already used in our earlier experiments and found less suitable for Karachi and adjoining areas as compared to the TP<sub>2</sub> variety [11], only the latter has been used in our present experiments. The germ plasm used in our experiments was produced locally during our earlier experiments.

A small plot of virgin land 20 metre long and 10.5 metres wide was selected in the premises of PCSIR, Karachi Laboratories, for the required experiments on TP<sub>2</sub> variety. The thickly grown weeds were removed and the plot was thoroughly ploughed. Afterwards 95 cu ft. well composted cowdung manure was evenly distributed in the above plot and it was re-ploughed so that the manure might get properly mixed and evenly distributed throughout. The plot was then left for about a fortnight before the seeds were sown. The ground was not irrigated during all this time. Suitable lengthwise ridges were made in the plot. The distance between the two adjacent ridges was 1.2 metre. One hundred and ninety-five seeds were sown 1.2 metre apart on the edges of irrigation channels in a well

Table 3. Amino acid composition of the protein of winged bean as compared to soybean, expressed as g/100 of protein; (data taken from the booklet on winged bean, published by the National Academy of Sciences, USA, 1975

Amino acid	Winged bean	Soybean
Cystine	1.6-2.6	1.2
Lysine	7.4-8.0	6.6
Histidine	2.7	2.5
Arginine	6.5-6.6	7.0
Aspartic acid	11.5-12.5	8.3
Threonine	4.3-4.5	3.9
Serine	4.9-5.2	5.6
Glutamic acid	15.3-15.8	18.5
Proline	6.9-7.6	5.4
Glycine	4.3	3.8
Alanine	4.3	4.5
Valine	4.9-5.7	5.2
Methionine	1.2	1.2
Isoleucine	4.9-5.1	5.8
Leucine	8.6-9.2	7.6
Tyrosine	3.2	3.2
Phenylalanine	4.8-5.8	4.8
Tryptophan	1.0	1.2

Table 4. Fatty acid composition of seed of winged bean and soybean; (data taken from the booklet on winged bean, published by the National Academy of Sciences, USA, 1975)

Fatty acid	Winged bean	Soybean
	% by wt.	
14:0 Myristic	0.06	—
16:0 Palmitic	8.9-9.7	11.0
16:1 Palmitoleic	0.83	—
18:0 Stearic	5.7-5.9	4.0
18:1 Oleic	32.3-39.0	25.0
18:2 Linoleic	27.2-27.8	50.0
18:3 Linolenic	1.1-2.0	—
18:4 Parinaric	2.5	—
20:0 Arachidic	2.0	0.4
22:0 Behenic	13.4-15.5	0.3



drained plot. The seeds were sown 2-3 cm deep. Sowing of the seeds was done in the first week of July 1983. Daily watering was done from the sowing time till germination. Thereafter, plants were watered every 4th day till harvesting. When flowering started, 95 cu ft. cowdung manure was again supplied to the plants. Dates of sowing, germination, flowering and fruiting were noted regularly. The pH range during the experiment was recorded as 6.5-7.0. During the period of experimentation (July 1983 - March 1984) the mean temperature ranged from 8.6-36° and the humidity percentage 40-83. A photograph was also taken (photograph No. 1).



Photograph No. 1. *Psophocarpus tetragonolobus* (L.) DC.

## RESULTS

Dates of sowing, flowering, fruiting and other relevant data pertaining to experiments are as follows.

- (1) Date of sowing: 7.7.1983.
- (2) Period of seed germination: 11 days (10th July 1983).
- (3) Period of flower initiation: 96 days (11th October 1983).
- (4) Date of the completion of flowering: irregular (usually up to harvesting time).
- (5) Period of pod initiation: 120 days (5th November 1983).
- (6) Period of bean maturation: 153 days (7th December 1983).
- (7) Period of complete harvesting: 254 days (10th March 1984).

- (8) Size of pod: 18.75-31.25 cm.
- (9) Weight of a single green pod: 44-72 g.
- (10) Percentage of water in green pod: 80-85.
- (11) Average weight of a single dry seed: 400-500 mg.
- (12) Total pod yield: 250 kg from a plot of 20 x 10.5 metre.

## DISCUSSION

It has been claimed by T.N. Khan [4] that the winged bean is regarded as a crop of hot and humid tropics, but its distribution includes environments cooler drier and higher in latitude. He further said that the crop is cultivated from sea level up to elevations higher than 1800 m and from the Equator to latitude north of 20°C. This distribution corresponds within an annual rainfall of 70-410 cm; and an annual mean temperature range of 15-18°. Mean daily temperature warmer than 30° and cooler than 20°C are super and suboptimal respectively. The winged bean is generally described as a short-day plant and grows on a well drained acid soil (pH 4.3-7.5).

Keeping simultaneously in view the above ecological requirements of the winged bean and the conditions prevailing in Karachi it was considered worthwhile to try its introduction and cultivation in Karachi and the adjoining areas.

T.N. Khan and M. Aslam [10] had tried its cultivation at Perth, Australia and Faisalabad and both these places fall on latitude 31° south and 31° north respectively. The results were not encouraging and the pod yields at both the places were not high. These results also indicated the possibility that perhaps the latitude of Karachi (24°-54' north) would be more suitable as compared to that of Perth and Faisalabad. Although the rainfall at Karachi is scanty as compared to 70-140 cm. required for the proper growth of this plant, however, this factor was covered through proper irrigation. As far as the ideal temperature situation is concerned, it should have been 15-18° but at Karachi, although the mean temperature had gone as high as 31° and the maximum temperature about 40°, the plants survived satisfactorily. This may be attributed to acclimatization, as the seeds used for our experiments were from the 3rd generation of locally produced seeds. It is clearly indicative of the adaptability of the TP<sub>2</sub> variety of winged bean under high temperature conditions.

As far as the minimum temperature is concerned, the plants were exposed to 8.6-9.5° and casually 4° but they survived. This is also indicative of the low temperature adaptability for short durations. The pH of Karachi soil (6.5-7.0) somewhat coincided with the requirements as



mentioned earlier (4.3–7.5). The latitude of Karachi (24°–54' north) being between 20°–30° north was also found suitable. Although the overall cultivation of the winged bean was successful, cold spell during January and February precluded the maturation and setting of the fruits.

Efforts were also made by Pakistan Agriculture Council at Islamabad to cultivate the TP<sub>2</sub> variety of the winged bean along with others in 1982 and 1983 (personal correspondence) but the results were not encouraging. It is said that the vegetative growth of the plant was excellent, flowering was also observed, and in very few cases there was pod formation. In other words, these results were more or less similar to those obtained by T.N. Khan and M. Aslam [10] at Perth and Faisalabad. The winged bean was also tried at the Plant Introduction Centre, Karachi but the results were more or less the same.

From our experience and overall results, the following conclusions could be safely drawn:

- (1) Cultivation of TP<sub>2</sub> variety has encouraging prospects for Karachi and the adjoining areas.
- (2) Irrespective of the date of sowing, flowering is initiated in the month of October.
- (3) Hardly any disease has been noticed. However, insects commonly found on vegetable crops in the adjoining areas are noticed from time to time.

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