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TUMBA AND MATEERA CULTIVATION IN THE INDIAN ARID ZONE

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PREFACE

Tumba (Citrullus colocynthis (L.) Schrad) and *mateera (Citrullus lanatus* Thumb) are important cucurbits of the Indian arid ecosystem. While *mateera* is cultivated, *tumba* grows wildly on sand dunes and sandy plains. *Mateera* fruits are consumed by human beings while *tumba* fruits are used as fodder for livestock. Fortunately seeds of both the cucurbits are rich in oil, though nonedible, which is used in the soap industry and also as lubricant. Thus these cucurbits give an opportunity to harvest economic returns from sand dunes, besides acting as good sand binder. Considerable work on *mateera* and *tumba* has been undertaken at the Regional Research Station of this Institute at Bikaner. I compliment the authors for compiling the available information on these two plants of the desert and I hope the Bulletin will be found useful by both the farmers and researchers.

J. Venkateswarlu
DIRECTOR

CONTENTS

TUMBA AND MATEERA CULTIVATION IN THE INDIAN ARID ZONE

The arid zone of north western India (22°N to 30°N latitude and 70°E to 77°E longitude) covers an area of 2,86,000 sq. km. The major characteristics of the region are high day time temperature, poor precipitation, high wind velocity, and frequent droughts. The vegetation cover is scanty and sand drifting is common (Plate 1).

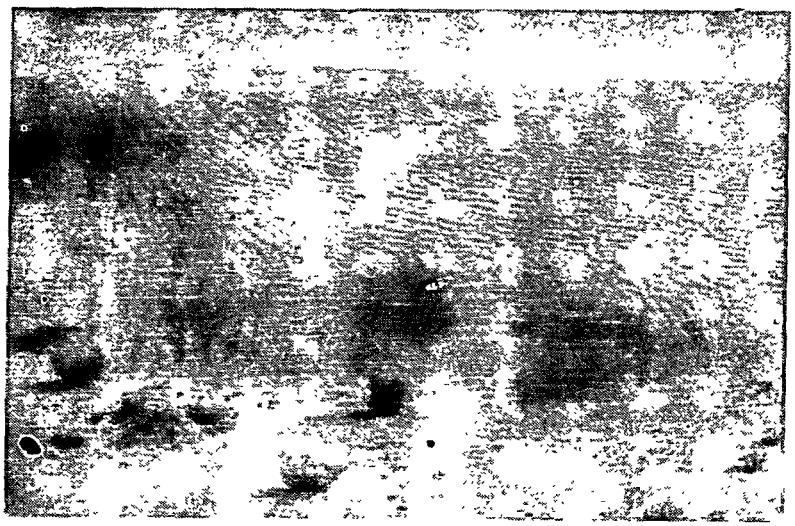

Plate 1. A typical desert scene in western Rajasthan.

The climate of the Indian arid zone is characterised by scarce and highly variable precipitation, extreme variations of diurnal and annual temperatures and high degree of evaporation. July and August are the principal rainy months and there is generally some rain in the month of June and September. The annual rainfall varies from 15 to 50 cm, with the lowest values being true for extereme western parts of the region. The average annual rainfall in the region is 30 cm, and 89% of this rain is received during the south-west monsoon season. The maximum air temperature reaches up to 50°C in summer and the minimum value may go down to -2.5°C or less in

winter over some parts. Relative humidity is maximum in July and minimum in April, both in the morning and in the evening hours. High wind speeds from the south-west or west are frequent almost throughout the year, the highest speeds being experienced in June and the lowest in December. The main climatic characteristics of the region have been given in Table 1.

Table 1. Climatic conditions at Bikaner (average of values from 1976 to 1986)

Month	Rainfall (mm)	Temperature (°C) Max.	Min.	Mean surface evaporation (mm day-1)	Wind velocity (km hr-1)
Jan.	5.1	22.5	4.5	3.7	4.9
Feb.	9.1	25.1	8.2	5.4	6.0
Mar.	8 4	3 .2	14.2	13.5	7.2
Apr.	11.3	37.8	21 1	17.7	9.2
May	20.4	41.4	25.4	18.3	12.2
Jun.	42.9	41.4	28.1	12.0	15.9
Jul.	110.0	36.9	26.9	10.3	13.9
Aug.	67.4	36.2	25 9	9.5	9.2
Sep.	48.0	36.1	23.9	9.5	9.2
Oct.	8.1	35.6	17.8	8.1	5.7
Nov.	5.1	30.5	11.9	5.5	5.0
Dec.	0.4	24.6	5 9	3.7	3.4
Mean Annual	336.1	33.3	17.8	9.7	8.8

The soils of the western Rajasthan are sandy with low organic carbon content, poor water holding capacity and a high infiltration rate (Table 2). The physical condition of the soil is, however, favourable for plant growth although the nutrient contents are low and imbalanced. Potassium is found in abundance in the soil while phosphorus is relatively low and deficiency of micronutrients is very common. The scanty vegetation results in poor organic matter and nitrogen contents of the soil.

Table 2. Physical properties of soils Bikaner soils

Soil property	Value
Coarse (%)	10.0 to 30.0
Fine sand (%)	65.0 to 80.5
Silt (%)	1.5 to 4.0
Clay (%)	2.6 to 6.0
Organic matter (%)	0.26
Bulk density - surface (g cc^{-1})	15.0
subsurface (g cc^{-1})	1.5 to 1.6
Moisture at 1/3 bar (%)	8.0 to 10 0
Moisture at 15 bar (%)	2.0 to 3.0
Infiltration rate (cm hr^{-1})	15.0 to 30.0

TUMBA (Citrullus colocynthis (L.) Schrad*)*

INTRODUCTION

Most of the area in the Indian desert is sandy with scanty vegetation. Regenerating a better plant cover on the surface is very important for improvement of the land. Successful introduction and domestication of some economically important plants will not only help in increasing the vegetation cover but may also improve the economy of the people living in these areas. Only few plants of selected families are well adapted to the xeric conditions of the desert. One of these families is cucurbitaceae to which belong *tumba*, *mateera*, *kachra*, etc., which are some of the naturally and commonly occurring plants of the Indian desert. The least exploited among these desert cucurbits is *tumba*, although it has a potential for varied uses. A general understanding of various aspects like habit, botanical characters, agronomic practices and uses of *tumba* may help in usefully exploiting this cucurbit of the Indian desert.

HABIT AND HABITAT

Tumba is perennial, trailing, scabrid herb belonging to the family cucurbitaceae. It continues for 3 to 5 years after establishment. It is a native of Africa, but is now found throughout our country. It is one of the important cucurbits having better xerophytic adaptations which are of more economic importance and hence it has been recommended for introduction and domestication in the Indian desert (Singh, 1964). It is quick growing plant which flowers in 30 days only and starts fruiting within 60 days after sowing. It is a boon for controlling and stabilizing sand dunes due to its creeping nature and having roots with sand binding ability (Plate 2).

BOTANICAL DESCRIPTION

Stem: The stem is angular, slender, branched, hirsute when young. Tendrils usually simple, slender, short, scabidrhisute below, almost glabrous above the lower straight portion, persistent.

Root: It has a well developed long tap root system which extends 3 to 5 m depth making it considerably drought resistant (Plate 3).

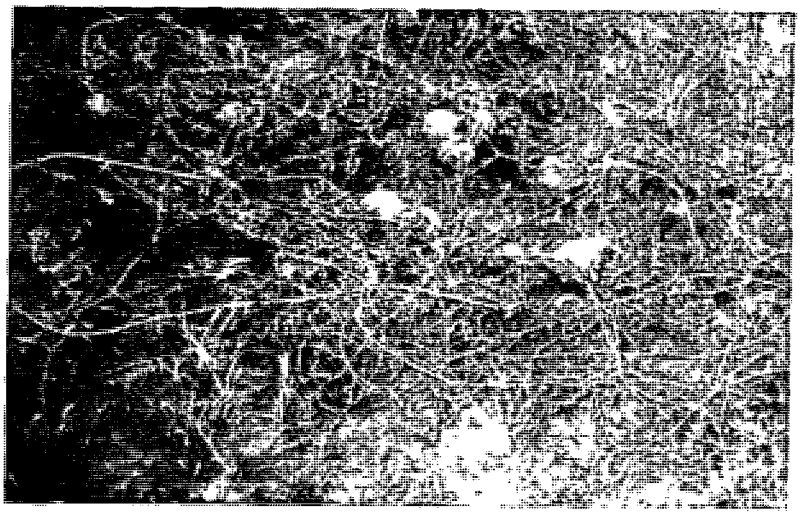

Plate 2. *Tumba* plant with heavy fruiting under natural oondition, a better competitor of weeds.

Plate 3. Longer root and narrow leaves (typical xerophytic characteristics) of *tumba* plant.

Leaves: Leaves are 3 to 6 cm x 2.5 cm, deltoid in outline, vigid, deeply three lobed, mid-lobe largest, each lobe pinnatified or sinuate, obtuse or acute, margins crisped, recurved pale g·een lower surface in young leaves, densely hirsute, petioles 2 to 4 cm, terete, scabrid hirsute.

Flowers: Male flowers 1 to 2 cm, peduncle, calyx tube companulate, 4 to 5 mm long, green, covered with white, scabrid hispid hairs, sepals 3.5 to 4 mm long green obtuse. Corolla green on outside and yellowish green inside, lobes 8 to 10 x 5 to 6 mm ovate. Stamens three.

Fruits: Fruits globular, 5 to 8 cm in diameter, variegated green mottled with yellowish blotches, arranged in undulating bands (Plate 4). Pulp very bitter and epicarp thin.

Plate 4. *Tuuba* plant with immature fruits.

Seeds: Seeds are obvate, 6 x 3 to 3.2 x 1.5 mm, compressed, pale brown, smooth, not margined, with two oblique grooves one on each surface near the slightly narrowed base.

NUTRITIVE VALUE

The fruit contains a well known crystalline glucoside colocynthin and the seeds contain 20% oil and 11% protein. The nutritive value has been given in Table 3.

Table 3. Chemical composition of *Tumba*

Fruit parts	Nitrogen (%)	Protein (%)	Phosphorus (%)	Potassium (%)
Seed	1 83	11.43	0.012	0.33
Pulp	1.70	10.62	0 012	—
Skin	1.77	11.06	0.012	—

(Source : Singh and Pawa, 1989)

AGRONOMIC PRACTICES

Field preparation: The sandy soils do not need much field preparation but the field should be free from weeds/grasses at the time of sowing.

Seed selection and treatment: There is no specific superior variety of *tumba*. A variety known as Desert Local is considered reasonably good. The selection of healthy seeds should be done by dipping the seed in 5% NaCl solution. The floating seeds should be removed and the settled seeds should be collected for sowing.

The germination of *tumba* seeds is beset with problems. For better germination, the seeds require prolonged soil incubation. Therefore, for successful germination of *tumba*, soaked seeds are kept underground at 20 cm depth in moist pits at 30 to 35° C temperature. After 10 to 12 days, the seeds start sprouting and when 5% of the seeds sprout they become ready for sowing. These treated seeds when sown in the field, start emerging within 12 to 15 days.

Sowing: The early sowing of *tumba* is done at the onset of monsoon and late sowing could be done upto mid August. The seeds of incubated *tumba* may be sown in two ways; (1) the seeds may be drilled in the field by opening the furrows, or (ii) the seeds may be sown in pits which is the best method for higher *tumba* seed yield. In this method 2 to 3 incubated seeds are sown in each pit which are at 120 cm x 120 cm distance. Before sowing in pits, 2 t ha^{-1} FYM and 5 kg ha^{-1} BHC dust must be incorporated in the soil. Initially, a seed rate of 3 kg ha^{-1} should be used. Only a single plant per pit should be maintained by thinning the seedlings 10 to 15 days after germination. The experimental results of a 3 year study conducted at Bikaner are given in Table 4.

Table 4. Yield of *tumba* as affected by method of sowing and spacing

Treatments	No. of fruits (thousand ha^{-1})				Seed yield (kg ha^{-1})			
	1980	1981	1982	mean	1980	1981	1982	mean
Method of sowing								
Furrows	58	53	52	54.0	372	509	276	385
Pits	31	52	45	49.3	330	540	305	391
Flat	30	42	27	33.0	367	490	278	378
CD 5%	—	NS	NS	—	NS	NS	NS	—
Row spacing (cm)								
60 x 60	56	43	38	45.7	296	448	271	238
90 x 90	46	53	43	47.0	319	473	253	315
120 x 120	56	22		49.7	433	497	325	418
CD 5%	—	6	NS	—	43	NS	48	—

(Source : Singh, 1982)

Manures and fertilisers: At the time of sowing FYM at the rate of 2 t ha^{-1} should be incorporated in the field. Generally, the crop is grown under rainfed conditions, therefore, 30 days after germination in case of good rainfall. 80 kg ha^{-1} nitrogen should be top dressed for better growth of the plants. Application of phosphorus and potassium is not necessary. The results of experiments conducted at Bikaner for 3 consecutive years are given in Table 5.

Table 5. Effect of nitrogen doses on yield of *tumba*

Nitrogen	Fruit number (thousand ha^{-1})				Seed yield (kg ha^{-1})			
(kg ha^{-1})	1980	1981	1982	mean	1980	1981	1982	mean
0	63	43	42	50.0	397	425	280	367
20	53	48	42	50.0	373	501	293	389
40	39	56	40	45 0	301	490	287	392
CD 5%	—	—	NS	—	NS	65	NS	—

(Source : Singh, 1982)

Weeding and interculture : In the early stages plant growth is not sufficiently good and the annual fast growing weeds supress it. Hence, two weeding cum hoeing operations, one at 20 days and another at 45 days after sowing, should be done for better growth of *tumba* vine.

Plant protection: Generally, *tumba* is not affected by any serious pest or disease, however, attacks of *tumba* beetle have been noticed. At the vegetative phase, the leaves are damaged by these *tumba* beetles. Two sprays of carbaryl 0.2% at 10 to 15 day interval proved effective for controlling these beetles.

Harvesting and yield: The green fruits are fed to animals and the matured yellow fruits are picked, dried and threshed for seed purpose. Air dried fruit yield of 120 to 150 q ha^{-1} and a mean seed yield of 450 kg ha^{-1} can be obtained by better management practices.

USES OF *TUMBA*

Medicinal: The fruits are of high medicinal value. These are used in the indigenous system of medicine and as a purgative.

Industrial: The seed contains 20% oil and 11% protein. Oil extracted from *tumba* seed is used for manufacturing soap, candles etc. It forms a basic raw material for the soap industry in Rajasthan.

As feed: The fruits are used as a feed for cattle, goats and camels. In a study *tumba* cake was fed every day to cows @25% of concentrate allocation for 37 days and no adverse effect of it on milking cows was noticed upto this level. The seeds

are buried in common salt to wash off their bitter principles, dried, mixed with pearl millet seeds and flour and eaten by the rural poor in scarcity periods.

MATEERA (Citrullus lanatus Thumb)

The *mateera* fruits are quite similar to *tarbooz* grown generally on river bed sands. The plants are very resistant to drought due to their well developed root system and are well adapted to the soil and climatic conditions of the desert (Plates 5 and 6). The crop is cultivated on barren sand dunes which cover large areas of western Rajasthan. It is a self sown crop and is sometimes sown along with pearl millet and extensively grown commercially at places like Bikaner, Pachpadra and Phalodi. It grows well on sandy plains, sandy undulating plains and sand dunes.

BOTANICAL DESCRIPTION

Stem : It is trailing, hispid annual, stem is herbaceous, 3 m long, young plant sensely lanate, villous, hairs curved, older parts glabercent, tendrils stout, bifid, and pubescent.

Leaves : Leaf size of 6.15 cm x 4 cm x 10 cm, ovate or triangular ovate, in outline scakrous on both surface, densely so on nerves below, deeply trifid lobulate to pinnati lobed, obovate, segments oblong to linear lanceolate, petioles 3 to 8 cm long sulcate, hispid.

Flowers : Male flowers on the axil of the spoon shape. 8 to 10 mm x 3 to 4 mm bracts on a elongate, 1 to 5 cm long villous peduncle, calyx tube broadly campanulatee, villous, sepals as long as the calyx tube. Corolla 2. 5 cm to 3. 0 cm in diameter usually greenish outside and pale-yellow inside. Female flowers peduncle 2 to 6, long calyx and corolla as in male flowers, ovary oblong lanate, style slender, 4 to 5 mm long.

Fruit : Fruits are globose, subglobose or ellipsoid 15 to 20 cm in diameter, smooth, green in colour, mottled with longitudinal irregular bands of dark green or uniform in colour, paricarop hard, pulp white, pink or reddish (Plate 7).

Seeds: Seeds numerous, 6 to 10 mm long, pysiform, compressed dark brown or even black, pink, white or mottled.

NUTRITIVE VALUE

The immature green fruits at the tender stage contain protein, carbohydrate, fat, crude fibre, calcium and phosphorus in appreciable quantities. The seeds contain kernels which are rich in edible oil (40%), crude protein (30%) (Table 6), etc. The extracted oil is pale-yellow having pleasant odour and taste.

Plate 5. Growing vine of *Mateera*

Plate 6. Better root development in *mateera* makes if a drought tolerant crop

Plate 7. Developed vine of *mateera* with a growing fruit.

Table 6. Chemical composition of *mateera* fruit

Fruit part	Nitrogen (%)	Protein (%)	Phosphorus (%)	Potassium (%)
Seed	1.65	10.31	0.012	0.27
Pulp	1.75	10.93	0 011	—
Skin	1.63	10.18	0.001	—

(Source : Singh and Bawa, 1989)

AGRONOMIC PRACTICES

Field preparation: Field preparation, for *mateera* cultivation does not require deep ploughing. The aim here should be to make the field free from weeds and to conserve moisture in the soil during winter rains for the spring or summer season *mateera* crop. One to two ploughings are sufficient to control the weeds and for conserving the winter rains in the soil in the deeper layers.

Seed selection and treatment: Seed quality plays an important role on the yield of *mateera*. Healthy seeds with better germination percentage should be selected for sowing. The seeds should be dipped in 5% NaCl solution. The seeds floating on the

surface should be removed and only the settled seeds at the bottom should be used for sowing.

For early germination, soaked *mateera* seeds should be incubated in moist pits for 24 hours at 30 to 40°C temperature and then the seeds are used for sowing. There is no specific *mateera* variety but the variety known as Desert Local is considered good.

Sowing: The main crop is grown during *kharif* season as a rainfed crop at the onset of the monsoon in the last week of June to the first week of July. Different methods which can be adopted for sowing are described below.

Furrow method: Furrows are opened at 90 cm distances and the incubated seeds are sown at about 2 to 3 cm depth in the furrows. After 10 to 15 days of sowing the plant to plant distances are maintained at 90 cm.

Pit method: Pits of 15 cm x 15 cm x 15 cm size are made in the field at distances of 90 cm x 90 cm and 2 to 3 incubated seeds are sown at 1 to 2 cm depth in each pit. Before sowing 2 g per pit of aldrin or BHC dust is incorporated in the soil in each pit to protect the crop from termite infestation. If the moisture is not sufficient application of 0.5 to 1.0 litre water per pit is very useful for successful germination. 15 to 20 days after sowing only one plant should be left in each pit by thinning.

Flat method: The crop can also be sown in flat fields without making the furrows or pits. The seeds are dibbled at distances of 90 cm x 90 cm. But before sowing, FYM @ 1 to 2 t ha^{-1} along with BHC @ 10 to 15 kg ha^{-1} should be mixed with the soil at the time of land preparation. For optimum plant population a seed rate of 5 to 6 kg ha^{-1} should be used. The experimental results of 3 years of work conducted at Regional Research Station, Bikaner have been given in Table 7.

Table 7. Effect of method of showing and specing on yield of *mateera*

Treatments	No. of fruits (thousand ha^{-1})			Seed yield (kg ha^{-1})			
	1981	1982	mean	1980	1981	1982	mean
Method of sowing							
Fnrrows	14	14	14	81.25		8.19	42.96
Pits	18	12	15	77.25	73.64	10.03	50.25
Flat	14	11	12.5	54.70	70.08	11.81	34.92
CD 5%	NS	NS	—	NS	NS	—	—
Row spacing (cm)							
60 X 60	20	13	16.5	75.54	79.58	11.53	44.20
90 X 90	15	12	13.5	71.60	70.96	9.22	43.25
120 X 120	11	15	11.5	66.66	115.26	9.20	49.87
CD 5%	2	NS	—	3.70	NS	NS	—

(Source : Singh, 1982)

Plate 8. Checker-board-system (3m x 3m apart) of mulching in *mateera* crop.

MULCHING

In the arid region, mulching is very important because the high temperature, wind velocity and loose sandy soils create serious wind erosion problems. Therefore, microwind breaks are erected by using local weeds like *senia* (*Crotalaria burea*) and *buee* (*Aerva pseudotomentosa*) in a checker board system (Plate 8), 3 m x 3 m apart, to check soil erosion and also to protect the young seedlings from injury by the wind blown heated sand particles.

MANURES AND FERTILIZERS

Manures and fertilizers both play an important role in the production of *mateera*. Application of FYM @ 2 t ha^{-1} is very important for increasing the water holding capacity of the soil. At the time of sowing nitrogen (20 kg ha^{-1}) and phosphate (10 kg ha^{-1}) should be applied in the furrows or pits according to the convenience of the farmers. 30 days after sowing another 20 kg ha^{-1} nitrogen should be applied after irrigation or after the onset of rains. The experimental results of 3 years of work conducted at Bikaner are shown in Table 8.

IRRIGATION

The summer crop is grown only where irrigation facilities are availble, two to three irrigations at 10 to 15 days interval are sufficient for establishment of the seedlings and for proper development of the plants and fruits. The *kharif* crop is grown generally under rainfed conditions but at the time of long dry spells during the crop season, one life saving irrigation is a must for protecting the crop from drought.

Table 8. Effect of nitrogen doses on yield of *mateera*

Nitrogen	Fruit number (thousand ha^{-1})			Fruit yield (kg ha^{-1})			
(kg ha^{-1})	1981	1982	mean	1980	1981	1982	mean
0	16	12	14.0	72.85	70.55	11.28	51.56
20	17	12	14.5	71.75	70.70	11.54	51.33
40	13	13	13.0	69.52	76.73	7.18	51.14
CD 5%	2.0	NS	—	3.75	NS	NS	—

(Source : Singh, 1982)

WEED CONTROL

The summer crop requires less number of weedings than *kharif* crop due to less weed infestation. But interculture operations are a must in crops of both the seasons. The fineness of the surface soil acts as a surface crust mulch. So one weeding at 20 to 30 days after germination considerably increases the moisture availability and crop growth.

PLANT PROTECTION

The adult grubs of *Katra* or mateera-beetle feed on the *mateera* leaves but in case of heavy infestation they can also feed on the fruits. The damage is caused by destruction of the leaves which ultimately dry up and fall off. Spraying of 0.2 % carbaryl or 0.045% monocrotophos 15 to 30 days after germination was found to be effective. Destruction of eggs laid on the leaves during March and July also induces the infestation.

YIELD

The first picking of fruits is done 25 to 60 days after sowing followed by two subsequent pickings at 10 to 15 day intervals. The crop matures between 100 to 150 days and a good crop can yield 50 to 55 q fruits per hectare.

USES

Mateera is generally known as the poor man's vegetable and the common man's fruit in the desert. The small green fruits are consumed as vegetable. The plant is very useful for the economic utilization of barren sand dunes. The seeds contain 20 to 40% oil which is largely used in the soap industry. The dry fruit rinds are given to animals as feed. The oil cake may be fed to the cattle and may also be used as organic manure. The dried seeds are used both as human and animal foods.

ACKNOWLEDGMENTS

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