CHAPTER II

TOPOGRAPHY OF THE REGION AND ABOUT THE PLANTS
The Marathwada region

Maharashtra state forms a major part of peninsular India with the sea coast on the western side. Marathwada region of this state includes seven districts viz. Aurangabad, Parbhani, Nanded, Beed, Osmanabad, Jalna and Latur. The geographical area of the Marathwada region is 64798 km$^2$ and falls within North latitude $17^\circ$ 35' and $20^\circ$ 40' and East longitude $74^\circ$ 40' and $78^\circ$ 15'.

Rivers

All the districts lie on the Deccan table land with a slope towards the southeast. The rivers Godavari, Purna and Penganga with a number of their tributaries form the major drainage system. The main rivers in conformity with the general topography flow towards the southeast.

Hills

Ajantha range of hills pass through the northern parts of Nanded, Parbhani and Aurangabad districts. Balghat hills in Beed district extend towards the north and enter into the southern part of Parbhani district. The altitude varies from 300 metres to 1000 metres above the mean sea level. The plateau has an average altitude of about 667 metres above the mean sea level.
Soils

The major portion of Marathwada has deep black, clayey and alkaline (pH 7.2 to 8.5) soils. The clay content varies from 30 to 70%. Variation occur according to the sites, underground rocks, altitude and the degree of erosion. They vary in texture, fertility and depth. The water infiltration rate is poor. The cation exchange capacity is about 50 m.e./100 g of soil and the predominant cation being calcium. The soils are rich in potash but poor in nitrogen and organic matter.

Climate

Marathwada has a typical tropical climate, more or less uniform throughout the seven districts. The maximum temperature can raise up to 46°C during May at Nanded. The summer days are generally severe during April and May. Monsoon normally begins in June and lasts till mid October. During this period, the region gets rains from south-west monsoon. The normal rainfall is about 900 mm but is rather variable from year to year. Nanded district receives the maximum rainfall while Beed district the least. Winter season is pleasant and lasts from mid October to the first week of March.
MAHARASHTRA STATE SHOWING 7 DISTRICTS OF MARATHWADA
Agriculture

In this region about 80% population is engaged in agriculture. According to 1979-80 Government statistics the total cropped area was 5,490,800 ha and the net area under irrigation was 4,72,600 ha.

Forest

The forest area in Marathwada region is 2,23,800 ha. There are mainly dry teak forests, dry mixed deciduous forests, dry grasslands and anjan forests. Grasslands are scattered over the region in small patches. Dry deciduous forests predominates and, at places, it often degenerates into a scrub jungle.

The Aurangabad district

Aurangabad is situated in the upper Godavari basin to the extreme northwest of Marathwada. In general the district slopes down towards the south and southeast. The elevation above the sea level varies between 665 and 735 metres on the north and between 565 and 635 metres towards the south.

Soils

Soils of Aurangabad district are medium to deep black and contain large amounts of calcium and magnesium
carbonates. These are deficient in available nitrogen and phosphorus. The soils are rich in potash and cracks heavily in summer. The soils are quite fertile and are particularly suitable for the cultivation of wheat, cotton, jowar and tobacco.

Climate

The climate of Aurangabad is pleasant and agreeable except in the summer season when the temperature rises to even as high as 43°C. However, in summer the nights are fairly cool. During rainy season the temperature does not fall below 17°C and normally ranges between 21 to 36°C. The winter season is completely dry. January is the coldest month of the year when the temperature often fall to as low as 4°C.

The Marathwada University Botanical Garden

The University Campus is located on the northwestern fringe of the city. The Botanical Garden is located at the centre of the Campus and near Botany Department building, which occupies an area of about 10 hectares. Since 1965, it is being developed as an experimental wing of the Botany Department. The Botanical Garden is surrounded by "nallah", almost on three sides. Adequate lift irrigation facilities
are available. The garden is also provided with a field laboratory (with IBP equipments), labour and supervision.

The meteorological data for Aurangabad during 1981-1984 are given at the end of this Chapter.

About the plants

Maize

Maize (*Zea mays* L.) is almost an ideal forage crop. It is quick growing, high yielding, palatable and nutritious (Whyte, 1964; Narayanan and Dabadghao, 1972; Relwani, 1979). In India maize can be grown in a wide range of climatic conditions.

The varieties recommended for fodder production include Ganga safed 2, Ganga 5 and Ganga 101 hybrids. Sowing of maize is usually done by drilling, with a spacing of 30 cm between the rows and 10-15 cm between the plants within a row. Normal seed rate is 40-50 kg/ha, however, it can also be sown at a rate of 60 kg/ha when thin stemmed leafy crop is preferred. The recommended fertilizer dose is 45-60 kg of N and 20-45 kg of P in the form of ammonium sulphate and superphosphate (Narayanan and Dabadghao, 1972). Different varieties of maize take from 60-90 days to harvest for fodder. The crop can be fed safely at any stage of growth.
The yield of fresh fodder varies from 157 - 280 quintals per hectare (Narayanan and Dabadghao, 1972). In monsoon one may expect the yield to the extent of 400 - 500 quintals (Relwani, 1979). At this farm, in 1972, the forage yield exceeded 260 quintals per hectare when the crop was fertilized with 150 kg N/ha (Mungikar, 1974). The crop yielded 550 quintals of green foliage in 1982 when P₂O₅ and K₂O were applied along with nitrogen (Dakore and Shahane, 1982).

The plant possesses a lean period of vegetative growth at the earlier stages, during which a pulse crop sown as intercrop can be established and give good amount of yield. Attempts to cultivate cowpea or Dolichos within the rows of maize were found beneficial during 1980 and 1981 on this farm (Kasture and Mungikar, 1984). Intercropping system with maize not only gives higher yields but also provides a well balanced fodder, rich in protein (Miller et al., 1963).

Maize is suitable for silage making. Being essentially a crop rich in carbohydrates, it makes good quality silage (Chatterjee and Maiti, 1978).

**Sorghum**

Sorghum or Jowar (Sorghum bicolor (L.) Moench) is an important fodder crop of this region. It has been grown in
India since prehistoric times. Natural selection and domestication over years has resulted in the development of numerous varieties. It is more drought resistant than maize, ideally suited in moderate rainfall areas.

The crop can be grown in a variety of soils, ranging from sandy to clayey loams. Line sowing method has been found better. The sowing is usually done by drill, 25 to 30 cm apart, using a seed rate of 30 - 40 kg per hectare. The crop is highly responsive to the application of nitrogenous fertilizers. On an average, the application of 80 kg N and 30 kg P per hectare has been recommended. The nitrogen requirements could be reduced, if Sorghum is preceded by a leguminous crop.

For fodder purpose, the crop should be cut immediately after flowering or up to 50 % flowering. Young Sorghum plant contains prussic acid, which is toxic to cattle or sheep. The crop is not usually dangerous if harvested at maturity, however, delayed harvesting increases crude fibre and decreases protein content in the foliage and results into a sharp decline in digestibility of nutrients. The hay and silage are generally free from prussic acid.

With excellent management, yields as high as 850 quintals have been reported from 3 - 4 cuttings (Relwani,
1979). The varieties MP chari, Maldandi, Nilwa, S-1049, M-35-1, PC-6 and CSH-5 are suitable for Maharashtra.

The growing of pure Sorghum for forage is a general practice, wherein the nutritive value of Sorghum remains low. Mixed cropping with cowpea, soyabean and gaur has been found to give higher yields and improve the quality. On this farm Sorghum was cultivated with either cowpea or Dolichos in 1981. The results obtained indicated an yield advantage over sole Sorghum cultivation (Kasture and Mungikar, 1981, 1984). Silage from Sorghum have slightly lower feed value than fresh Sorghum, but it is better than hay (Patel et al., 1968a).

Lucerne

Lucerne (Medicago sativa L.) is essentially grown for use as green fodder. Being a perennial crop, it is possible to maintain its productivity up to three years with a cost benefit ratio of 1:3 (Handa and Rakib, 1980). In Maharashtra it is grown in Nasik, Ahmedabad, Pune, Jalgaon and Aurangabad districts.

The sowing is generally done in the month of October, either by broadcasting the seeds or by drilling them in rows. After about 9 - 10 weeks the crop is ready to harvest. Subsequent regrowths can be harvested after every 30 days.
Average fodder yield vary from 850 - 900 quintals per hectare. Under high fertility, improved agronomic practices, superior germplasm and assured irrigation; the crop can yield annually 1200 - 1500 quintals of green fodder per hectare in 9 - 10 cuttings (Relwani, 1979). Field trials at this station confirmed that lucerne is a highly productive crop with consistent performance (Dev et al., 1974; Mungikar et al., 1976). Growing of lucerne in between the rows of Guinea grass can yield more fodder without increasing the area under cultivation (Patel et al., 1968b).

The green foliage of lucerne is very rich in protein, but never makes a good silage because of low dry matter and sugar content and high buffering capacity. Cows grazing on lucerne pastures may develop bloat. The young plants also contain undesirable saponins. The crop may also cause photosensitization if not fed properly.

**Cowpea**

Cowpea (*Vigna unguiculata* (L.) Walp) is a leguminous forage crop mainly grown in northern and central India. It gives protein rich green fodder for cattle, apart from its other uses as green manure, cover, vegetable or pulse crop. The crop is free from every type of toxicity.
The plant is herbaceous, annual; and either erect, prostrate, winding or trailing. It can be grown on variety of soils, thrives well in between 21 to 35°C and tolerate heavy rainfall as compared to other pulses. In India the crop is raised as a dryland kharif crop. It is cultivated either as a sole crop or mixed with maize, Sorghum, bajra, sudangrass, hybrid Napier grass, Guinea grass and sunflower. On this farm Kasture and Mungikar (1981, 1984) have shown the advantages of intercropping cowpea with either Sorghum or maize.

Cowpea is grown with moderate manuring at a seed rate of 40 kg/ha. The seeds are sown by either "pora" or "kera" in rows, placed 30 cm apart and 5 cm deep. The crop gets ready for cut as fodder after about 60 - 70 days. At this stage it has more than 50% leafiness with broad dark green and smooth leaves. In a two cut management, the first cut can be taken after about 50 days followed by a second cut (regrowth) after 30 - 40 days.

On an average the fodder yield of cowpea do not exceed 275 to 300 quintals per hectare, however, a yield of 350 to 400 quintals per hectare can be obtained with better management and multicut system (Relwani, 1979). On this farm Deshmukh (1972) reported yield of 42460 kg per hectare green fodder from this crop in 80 days during monsoon.
Cowpea makes an excellent hay; however, while conserving cowpea as silage it is desirable to mix it with carbohydrate rich cereal fodder to compensate high moisture and buffering capacity (Kasture et al., 1984).

Several varieties have been evolved by Haryana Agricultural University, Gujarat Agricultural University and the Indian Grassland and Fodder Research Institute (IGFRI). Two varieties, Pusa Barsati and Pusa Dophasli have been introduced in this region. These varieties are early maturing, trailing, comes to flower in 40 days and to pods in another 10 days.

**Dolichos**

Dolichos or *Lablab niger* Medicus (Syn. *Dolichos lablab* L.) is an important leguminous crop. It is widely grown in southeast Asia, Egypt and Sudan and have been introduced in other tropical zones including India. It is known as "Dhor wal" or "Wal papdi" in this region and is cultivated for pods as vegetable.

The plant can grow on a variety of soils, mostly on poor or laterite soils which do not possess any irrigation facilities. It resists drought but cannot tolerate water logging. The plant is a twiner giving dark green cover. It remains green and vigorous during the dry season. In this
region Dolichos is cultivated either for green manuring or for fodder, around the fields of sugarcane.

On this farm it was cultivated in summer of 1967 when it yielded about 70 quintals of green fodder per hectare (Deshmukh, 1972). In 1981, when grown in summer, the crop yielded 90 quintals green fodder per hectare (Kasture, 1982) with 18 to 24% crude protein on dry matter basis.

Hybrid Napier grass

In the year 1953, a cross was made in India between bajra (Pennisetum typhoides) and Napier grass (Pennisetum purpureum). This cross proved successful and became popular forage crop under the name hybrid Napier grass, Elephant grass or Gajaraj. It is more juicy, succulent and nutritious than the common Napier (Dabadghao, 1969) and yields from 210 to over 250 t of green fodder per hectare per year.

Several varieties of hybrid Napier grass have been raised by IARI, New Delhi, PAU, Ludhiana and other Research stations. A hybrid variety NB-21 has an universal acceptance due to its excellent performance in most parts of India. Although it grows better under moist conditions it is remarkably drought resistant. The crop propagates by stem cuttings or the tillers. It can be grown either alone or in association with legumes.
On this farm, with liberal dressings of fertilizers the crop yielded 250 t fresh vegetation from a hectare in one year (Gore et al., 1974). Hybrid Napier grass contain high amounts of oxalate which interfere with the utilization of calcium in animals (Patel et al., 1967; Relwani, 1979). It is therefore suggested that while using this fodder care should be taken for calcium supplementation.

**Groundnut**

Groundnut (*Arachis hypogaea* L.) is the main oil seed crop of India. Maharashtra state grows groundnut in about 8,50,000 hectares. In the Marathwada region a two crop rotation of groundnut (March - October) and wheat (November - February) is practiced.

The sowing is done by dibbling. The most common spacing recommended is 45 x 15 cm. Optimum sowing time for Maharashtra lies in the second half of June. The fertilizer doses recommended for groundnut, when taken as a rainfed crop, is 20-40-0 kg/ha N-P-K respectively. AK 12-24, SB-11 and recently released JL-24 (Phule Pragathi) are the important varieties under cultivation. Kharif groundnut is commonly grown mixed with Sorghum or sunflower.

The average productivity of groundnut in India is 830 kg/ha as compared to the world productivity of 900 kg/ha.
Hence intensive steps for increasing the productivity of this valuable protein rich oil seed crop are essential.

**Sunflower**

Sunflower (*Helianthus annuus* L.) is a novel oil seed crop. A native of Mexico and extensively grown in USSR has now come to stay in India. This "beautiful" crop aroused interest because of its quick growth, early maturity, drought avoidance and photo-non-sensitiveness. Sunflower yields oil rich seeds with low cultivation cost. Apart from this, it can also be grown for fodder and green manuring. In Maharashtra it is taken up as an intercrop in sugarcane, cotton and "Tur".

Sunflower locally known as "suryaful", "suryakanti" or "surajmukhi" is a stought, erect, annual plant with rough hairy stem terminating a head, generally measuring 30 to 40 cm in diameter. The seeds contain 35 - 45 % of oil. The sowing can be done by drilling, with a spacing of 15 cm between plants in rows, 40 - 50 cm apart. Since sunflower is day-neutral it can be sown at any time of the year. However, sowing in the months of February - March or in October - December is recommended for higher yields. The crop flowers after 70 - 90 days and the flowers come to seed about 3-6 weeks after flowering. At maturity head turns brown or black. The good crop yields about 8-15 quintals of seeds per hectare.
REFERENCES


