or till the leaf buds change into leaves, as it then indicates that rooting has taken place at the bottom. Sets from such over mature shoots make poor seed material. The latex content in over mature shoots of 'podies' is considerably less and shoots also become pithy.

For introducing in new areas where the seed material is not available in the neighbourhood, it is best to take the shoots from the fields immediately after harvest, transport them expeditiously to the destination and to put them into a 'podi' in the new area. Even here the shoot must be planted in 'podies' within 4 days. Seed materials from 'podies' of growing areas, however quickly they are transported has not given satisfactory viability. It is due to the fact that the latex content dries up very rapidly and the usual precautions of covering them during transport do not prove of much use.

Seed rate and planting. Usually a 'Podi' or a cartload and a half of material cut into nine-inch sets give about 12,000 sets and this will plant an acre. The sets are planted vertically at every junction of the two feet squares, one each, more than two thirds of the length being inside the ground level. If there is not sufficient moisture, one irrigation is given. The plants will begin to root and put out green leaf buds in about a week.

Intercultivation. Hoeing between the rows is done once a week in the first two months and once a fortnight for the next four months. Irrigation is given once a week when there are no rains. For normal plantings, beds containing five plants each way, are formed usually in January or February, as the south-west and the north-east monsoons will be able to provide enough water between the two, upto the end of December. After January, irrigation has to be continued right upto the day of harvest, once a week if the maximum yield is to be obtained. But in great many cases due to scarcity of water in the wells, the plants get hardly any irrigation but even there, it is found the yield is good enough to leave a margin of profit to the growers.

Harvesting: Just before the actual harvest commences the field is irrigated once. It is advisable to harvest early i. e., when the crop is six to eight months old, for marketing the crop as a vegetable. But, for making sago or flour or chips, it is better to allow the crops to stand for full eleven or twelve months. Actual harvesting operation is done by a man gripping the bottom of the shoot with both the hands firmly, with legs planted squarely and pulling out. In a few cases where portions of tubers remain lodged in the soil they are dug out with the mammuti. The pulled-out tubers are cleaned, steeped in mud and carted either to the market or to the factory as the case may be. The steeping in the mud is necessary for preserving the freshness. By this means, the tuber can be kept fresh for four days. Twenty labourers can pull out,

and clean, an acre's produce, i. e., about four tons. Even where the plants are fully twelve months old, the tubers can be kept on in the ground for another six months without damage. This is a favourable point for the sago manufacturer, as it gives him time to prolong his working period.

Yields: A normal crop gives eight to ten cart-loads or four to five tons of tubers per acre. Even where the irrigation has been inadequate the yield is two to three tons per acre. The best tubers weigh 9 to 10 lbs. though the general average will be only one pound or so. When sold as a vegetable a viss or $3\frac{1}{8}$ lbs. at $2\frac{1}{2}$ annas will fetch a return about 400 to 500 rupees per acre. After meeting the working expenses a normal crop leaves him Rs. 100/- per acre as net profit.

Manufacture of Sago: (As a cottage industry): Robust, well developed, freshly-pulled-out tubers are brought to the factory site. The outer skin is peeled off, either with hand or with a knife. The peeled tubers are scraped into fine, uniform shavings by means of a hand-driven scraping machine. The scraping machine consists of a horizontal spindle with sharp, small curved spikes or projections over its entire surface. In the middle of the rotary there is a two-inch wide groove. The rotary is connected to a cranked wheel, by means of a circular rope which passes round the wheel and along the grove of the rotary like a belt drive. By turning the wheel the rotary begins to rotate on its own axle. While it is rotating the tubers are gently pressed against its surface and the shavings that fall off are collected in a tray placed underneath. The shavings so collected are taken to a cement tub, and mixed with water. They are then transferred on to a cloth and strained. The out flowing liquid is collected in another cement tub, with plugged outlet holes at different levels. After two or three hours of standing, a floury white mass settles down and the supernatant water is drawn out by unplugging one of the outlets. The white powdery residue is dried for an hour or two and sieved by means of a special superfine meshed sieve till all the fine flour is separated. The coarse flour is mixed with the next charge in the first tub. The sieved fine flour is placed on a clean, dry white cloth and oscillated gently till they form into uniform small pellets. These are then graded by means of a suitable sieve, bagged and sold as sago. Coalesced pellets and the coarse grain are marketed as *tapioca rice*, at a slightly cheaper price.

The pulp, left over after straining the starchy liquid is dried and fed to cattle or made into fine flour and sold about at Re. 1/- per maund of 25 lbs. for making kumkum (saffron) or as a substitute for Fuller's earth, or kieselguhr for making face powder of a cheaper quality. One ton of tubers give one sixth of a ton of sago. During the war period a maund used to sell about Rs. 20/- and one acre's produce used to bring in a gross return of Rs. 1,200/-. The sago so manufactured keeps on its quality unspoiled for nearly a year.

Chips: (Sundried). After peeling off the skin, the tapioca tubers are cut into slices half an inch long and sun-dried for two days. This is used for curry or mixed in cooking along with meat and put to several other culinary uses. Fifty maunds of tubers give sixteen maunds of sun-dried chips or nearly one-third of it. The chips keep unspoiled for four or five months, provided it is sun-dried once a month.

Flour: Well-dried or dehydrat d chips are ground into fine flour and used as a substitute for rice flour, for almost all the preparations where rice flour happens to be the main constituent. Sixteen maunds of chips give about 13½ maunds of flour. The flour keeps on unspoiled, up to six months with occasional sun drying. The war-time price of flour used to be Rs. 45/- per cwt. The present price is about Rs. 22/- per cwt.

There is a great future for the growers of these subsidiary crops; with proper propaganda on the nutritive value of tapioca and sweet potatoes, many low-yielding sandy loams can be brought under these root crops with little expense and great profit. At present, the following factors are hampering maximum production. More than 50% of tapioca crops come to harvest after inadequate irrigation, due to want of water in the wells. A concerted drive to sink boreholes with the Government supplying the necessary equipment, even on a hire basis, will go a long way towards remedying the dearth of irrigation water. By starting processing factories for manufacture of sago and removing the export restrictions, and by conducting intensive propaganda for making greater use of the products of tapioca by the common man, the consumption and production of this crop can be stepped up to a considerable extent. Allotting manure purchase loans without interest at the time of sowing and collecting the same after harvest will also help the grower to increase the area under this useful food crop.

Natural crossing in Cumbu Pennisetum typhoides Stapf. and Hub.

By

P. KRISHNA RAO, Millet Specialist,
A. KUNHIKORAN NAMBIAR, Assistant Millet Specialist
and
I. V. G. KRISHNA MURTHY, Assistant in Millets
Millet Breeding Station, Coimbatore

Cumbu or *Bajra* is the second important millet of Madras coming next to sorghum. It occupies an area of 2·6 million acres in the Presidency and produces an outturn of 6,85,5000 tons of food grains annually. The natural crossing in cumbu was studied with a view to evolve high yielding hybrid strains in the crop, as a first step in it.