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U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN No. 168.

PEARL MILLET.

BY

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WASHINGTON:

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1903.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
Washington, D. C., April 1, 1903.

SIR: I have the honor to transmit herewith a paper on Pearl Millet, and respectfully recommend that it be published as a Farmers' Bulletin. This paper was prepared by Mr. Carleton R. Ball, Assistant Agrostologist, and was submitted by the Agrostologist.

Respectfully,

B. T. GALLOWAY,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

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PEARL MILLET.

INTRODUCTION.

The recent effort on the part of certain seedsmen in this country to revive interest in pearl millet by offering it under new and attractive names and at very high prices renders it desirable that a statement concerning its cultivation and uses should be made for the information of those who may be interested in green fodder crops. This crop has been grown more or less in this country for thirty years. It is known that under favorable conditions, particularly in the Southern States, it yields a large amount of green fodder. If utilized before the plant is mature the fodder is palatable, but if the plant be allowed to mature it becomes so woody as to be of little value. The most important difficulty in connection with its cultivation lies in the fact that the seed is rather unreliable. Most of those who have experimented with this crop have failed to secure a satisfactory stand. The Department of Agriculture has grown the crop experimentally for a number of years, and last year obtained seed from all the seedsmen in this country from whom it could be had, not only under the name of pearl millet but under the name of *Pencilaria* and Mand's Wonder Forage Plant, and they all proved to be practically the same thing. Consequently farmers who desire to try this crop are advised to purchase the seed under the name of pearl millet, as under this old and well-established name it is sold cheaper than under the new names.

DESCRIPTION.

Pearl millet (*Pennisetum spicatum* (L.) R. & S.) is a tall, erect, succulent annual grass, 6 to 15 feet high under cultivation; stem very leafy; leaves long and rather slender, not rough and only slightly if at all hairy; flowers borne in a long, slender, cylindrical spike (fig. 1), 6 to 14 inches long and 1 inch or less in diameter. When mature this spike is brownish in color and bears considerable resemblance to the fruiting spike of the common "cat-tail" or flag of our marshes, from which resemblance pearl millet gets the name of "cat-tail" millet, which is so frequently used.

The plant stools freely from the basal joints and also branches from the upper joints, producing heads on the main stem and also on the branches. In general appearance and habit of growth it much resembles corn and the sorghums, though rather more slender in stem and leaf and more branching in habit (fig. 2). Botanically it is more closely related to the foxtail millets and barnyard millet than to either corn or the sorghums.

COMMON NAMES.

The following common names have been applied to pearl millet at different times and in different places. This is by no means a complete list of the names applied to this plant in foreign countries, but is a fairly complete list of those used in the United States. The name "pearl millet" has been used more commonly in the United States than all the other names combined.

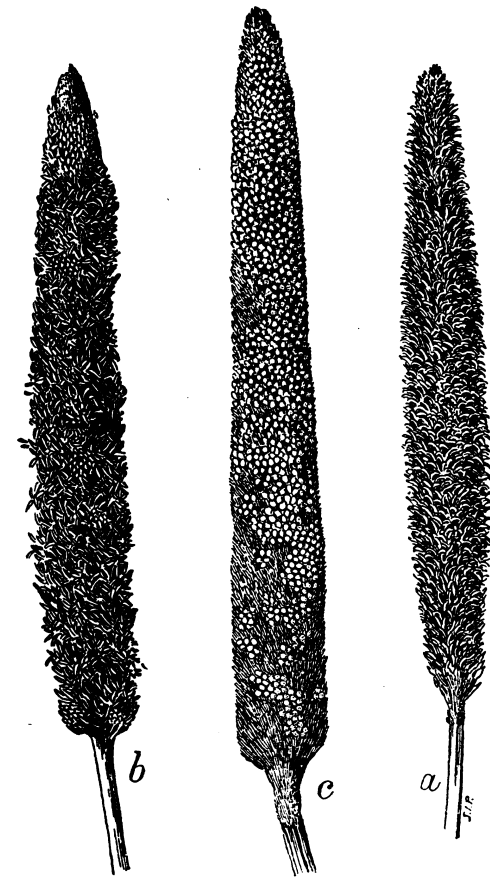


FIG. 1.—Heads of pearl millet: *a*, before blooming; *b*, in bloom; *c*, mature, showing seeds.

The names used for it in the Nile region are also applied to different varieties of sorghum which are likewise in common cultivation there:

UNITED STATES.

African cane.
African millet.
Bajree millet.
Black millet.
Brazilian millet.
Bulrush millet.
Cat-tail millet.
East Indian millet.
East Indian pearl millet.

UNITED STATES—continued.

Indian millet.
Egyptian millet.
Horse millet.
Japan millet.
Mand's wonder.
Mand's wonder forage plant.
Pearl millet.
Pencilaria, Pencillaria, or Penicillaria.
Pencilaria zeoides.

GERMANY.

Aeriges pinselgras.
 Geährtes darrgras.
 Negerhirse.
 Perlhirse.
 Perularia.
 Pinselhirse.

SPAIN.

Panizo de Daimiel.
 Panizo negro.

AFRICA.

Northern:
 Millet chandelle.
 Senegambia:
 Petit-mil.
 Egypt and Nile region:
 Dochan.
 Doche.
 Dogghe.
 East coast:
 Bajra.
 Hindi.

INDIA.

Bujera.
 Gantee.

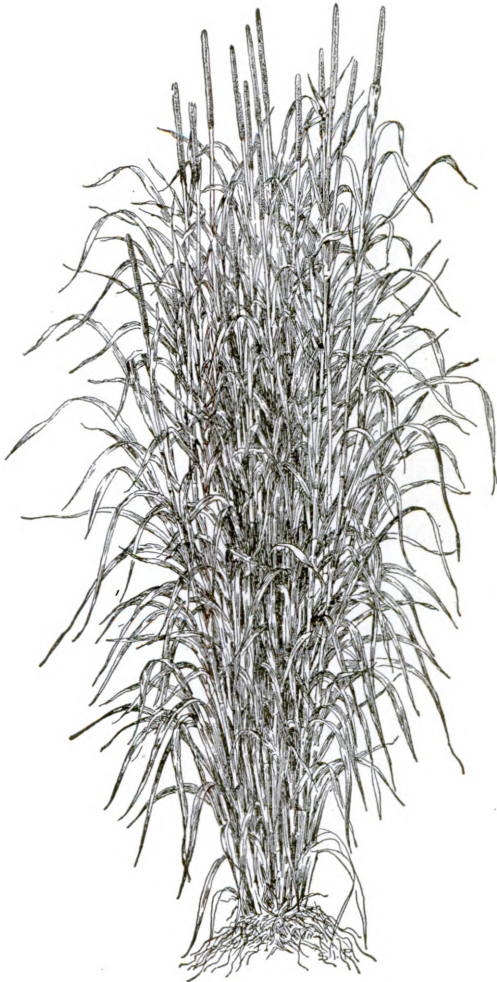


FIG. 2.—A single plant of pearl millet, 10 feet in height.

ORIGIN AND HISTORY.

The native home of pearl millet is not known. It belongs to a genus of grasses (*Pennisetum*) which is widely distributed in tropical and subtropical regions of the Old World, and to a lesser extent in South America and Central America. From the number of species which occur in Africa, and the extent to which pearl millet is cultivated there, it seems probable that tropical Africa is its native home. In India and adjacent regions, in Arabia, in Egypt, and in all the warmer parts of Africa, it has been known in cultivation for more than three hundred years as a forage and food plant. The grain is used very largely for human food and the whole plant for forage. It is also cultivated extensively in southern Europe. It was probably carried by the Spaniards to Mexico and South America at a very early date. The specimen described by Clusius in 1601 was supposed by him to have come from Peru. Pearl millet was very probably introduced into the United States

in the early fifties, at or about the same time that sorghum was brought to this country. It has certainly been cultivated in the Southern States since that time. Little attention was paid to it, however, and it was not until 1875 or later that its cultivation became at all general in that section. In 1878 a few samples of seed were sent out from the United States Department of Agriculture to private experimenters in several widely separated States. Most of these experimenters returned very favorable reports of its growth and value. Since that time there has been a steadily increasing appreciation of its value for green forage.

PENCILARIA, OR MAND'S WONDER FORAGE PLANT.

About three years ago a few seed firms began to advertise a wonderful new forage plant, some under the name of pencilaria, others under the name of Mand's wonder forage plant. Very exaggerated claims as to its productiveness and value were made. The new plant was said to be imported directly from South America, and no reference to its identity with the old pearl millet was made. Seed was sold at a very high price per pound, and the plant was recommended as being of the greatest value in both northern and southern latitudes, 80 to 100 tons of green forage being claimed as the usual average yield in five to eight cuttings per season.

The next season a strongly worded description and recommendation of the plant appeared in a reputable American horticultural journal and was soon copied abroad as far away as Australia. At the same time a seedsman in Germany displayed an extravagant advertisement of the plant in a German agricultural journal under the name of "Peruilaria." He offered the seeds for sale at the rate of 1 mark for 250 (10 for 1 cent). This is at the rate of \$69 per pound. The same exaggerated claims were made for its value in Germany, with its northern climate, as had been made in this country. The advertisement at once called forth a very able article from a German agriculturist stating the real facts about the plant and warning the public.

To the credit of our seed trade it must be stated that but a small percentage of the firms in this country have taken part in this movement. Among the 74 seedsmen whose catalogues were examined recently, 35 were found to be offering this plant for sale under some one or more of its names. Of these, 6 advertise Mand's wonder forage plant, and 3 of these quote pearl millet also as a distinct plant. Four advertise pencilaria, and 2 of these also quote pearl millet as a distinct plant. The remaining 25 firms quote pearl millet only, and most of them under this name. Three have stated that pencilaria and Mand's wonder forage plant were only new names for the old pearl millet.

The following table shows the number of seedsmen, out of 74 whose catalogues were examined, offering pearl millet under either its proper name or one of the above names, with the prices quoted for a pound of seed:

Number of seedsmen offering pearl millet seed under various names, and prices asked.

Pearl Millet.	Pencilaria.	Mand's Wonder Forage Plant.	Price per pound.
4	.....	.....	\$0.12
8	.....	.....	.15
4	.....	.....	.20
8	.....	.....	.25
2	.....	.....	.30
1	.....	.....	.35
1	.....	1	.40
	1	.....	.75
	1	2	.85
	1	3	1.00
2	.....	.....	1.50
			Not stated.
30	4	6	

The U. S. Department of Agriculture, during the past season, procured seed sold under all these names from as many seedsmen as possible and grew them in adjoining plats. The resulting plants were identical except for some minor differences of size and branching habit. It is not denied that there are several more or less distinct varieties of pearl millet in cultivation in India, Africa, and elsewhere. With careful selection it will be possible to produce strains, some of which will be earlier and hardier than others and consequently better adapted to northern conditions. Such varieties have not yet been separated in this country.

THE CULTURE OF PEARL MILLET.

SOILS.

Pearl millet, in its native lands, is found in rich moist alluvial soils, and it is in such soils that it gives the enormous yields so often reported in this country. The immense tonnage of fodder can be secured only at the expense of a very heavy draft on the plant food in the soil, and hence only very rich soils can stand the strain. In this respect pearl millet again shows its resemblance to corn and the different varieties of sorghums. Analyses made at the Georgia Experiment Station several years ago show that in a total yield per acre at three cuttings of 19,474 pounds, or nearly 10 tons, of cured fodder, there was withdrawn from the soil 1,833 pounds or nearly 1 ton of mineral matter. A heavier yield would, of course, represent a greater draining of soil fertility and a lighter yield a smaller draft upon it.

On poorer, clayey, or sandy soils the yield of forage will be proportionately decreased, but may still be comparatively valuable, since on poor soils the yield of any forage crop is necessarily diminished. Pearl millet thrives best in a warm soil, and a sandy loam is therefore better adapted to its needs than a heavier soil of equal fertility.



FIG. 3.—Growth of pearl millet on rich land.

No special preparation of the soil is necessary, but it should be deeply plowed and well pulverized, so as to conserve moisture if needed. Preparation should immediately precede the planting, so that weed growth may be checked during the time the young plants are starting.

SEED.

As previously noted, seed of pearl millet is on sale, under one or another of its names, by some 35 different seed firms in this country. Reports from farmers and others who have been trying this crop indicate that the quality of the seed is rather poor. From no growth at all to a half stand is commonly reported. To just what this is due is not yet clear. It may be the result of sowing the seed too deeply or before the ground becomes warm enough to start germination, in which case the seed would perhaps rot. The complaint has been so general, however, as to make it more probable that the fault lies in the seed itself. Pearl millet is a native of tropical and semitropical regions, but has been slowly acclimated farther north. In our Northern States it does not always ripen seed. It may well be that considerable unripe seed has been placed on the market in the last two or three years. No investigation of this point has been made. The weight of good cleaned seed varies from 48 to 56 pounds per bushel.

SOWING.

Directions for sowing given by different seedsmen and many experimenters vary widely. Pearl millet is usually sown in drills from 18 inches to 3 feet or more apart, depending on the purpose for which it is to be used. In the same way the plants in the rows may be very close together or from 4 to 6 inches apart. The greater distances between the rows and between the plants in the rows are given when the crop is desired for soiling or green feeding; the lesser distances when the crop is to be used for hay. Where it is to be used as a soiling crop and cut when from 2 to 4 feet high the large size of the stalks is not objectionable. Where it is intended for hay, large stalks are much more difficult to cure than small ones. Close planting of both rows and stalks will result in slender plants. Thicker sowing and therefore more seed will be required on poor soils than on rich ones, because on a poor soil the plants will tend to remain short and stocky in habit. For the thinner sowings in drills on good soils, only 3 or 4 pounds of seed will be required, or perhaps even less. For poorer soils, or thicker seeding, the amount of seed may be increased to 6 or 8 pounds per acre.

Where it is intended to cure the crop into hay, the seed may be sown broadcast. This will probably require about one-half bushel of seed per acre to insure crowding the stalks sufficiently to keep them slender. One bushel per acre has been recommended by some seed dealers, but a half bushel of good seed has been found enough for even a rather poor clay soil. When seed is broadcasted it is sometimes difficult to prevent the growth of weeds in the crop. If the weather

remains cold and the season backward, the germination and the early growth will be slower than usual. Weeds are then likely to get a start which will make them troublesome and injurious in a crop that can not be cultivated. In the case of a poor stand the same difficulty may be experienced.

Seed should not be sown until all danger of frost is past and the ground has become warm. This time will vary from early in April in the Gulf States to the last of May in the Northern States.

Care should be taken that seed be not covered too deeply when drilled, about one-half inch being sufficient. When broadcasted either the seed should be lightly harrowed in or the land should be rolled after planting.

CULTIVATION.

Where seed is sown broadcast no cultivation is possible. Where the seed is drilled it should be cultivated the same as corn and similar crops until its size renders this both impossible and unnecessary. If soil moisture is not abundant enough it is best to continue surface or shallow cultivation, and thus prevent evaporation. Similar cultivation may be given between cuttings, as required. Hand hoeing may be necessary to remove weeds from the rows.

YIELD OF FORAGE.

One of the striking features of many of the recent accounts and advertisements of this plant is the glowing statement of the enormous yields pearl millet commonly produces. Yields of from 75 to 100 tons of green forage per acre are said to be quite the ordinary returns. As a matter of fact, when a good stand is secured, pearl millet exceeds in productiveness the ordinary sweet sorghum or cane and also the nonsaccharine sorghums. Among the succulent soiling crops it is probably exceeded only by teosinte in the number of tons of green forage produced.

Below are given some of the recorded yields of green and dry forage. It will be noted that about 40 tons is the heaviest yield of green fodder and 16.4 tons the largest yield of dry or cured forage. Wonderful as are these yields, they do not at all substantiate the extravagant and misleading claims made for pearl millet as it is sold under high-sounding names.

Recorded yields of pearl millet in the United States.

Where grown and where recorded.	Green forage, per acre.				Cured into hay, per acre.				
	First cutting.	Second cutting.	Third cutting.	Total.	First cutting.	Second cutting.	Third cutting.	Total.	
	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Tons.</i>
Alabama (Canebrake Bul. 9) .	13,800			13,800				2,900	1.45
Arkansas (Bul. 27) .					4,800			4,800	2.40
Arkansas (Bul. 34) .					9,600			9,600	4.80
California (U. S. Dept. Agr. Rpt., 1879) .	63,000			63,000					
Delaware (Ann. Rpt. 8) .	9,964			9,964					
Georgia (Bul. 12) .	11,960	28,288	7,800	48,048	3,120	10,816	5,538	19,474	9.75
Georgia (Bul. 17) .	12,064	28,880	11,472	52,416	2,163	3,910	2,995	9,068	4.53
Kentucky (Bul. 98) .	41,600	88,720		80,320	14,400	18,400		32,800	16.40
Louisiana (Bul. 29) .	16,000			16,000					
Louisiana (Bul. 47) .	13,031			13,031					
Massachusetts (U. S. Dept. Agr. Rpt., 1879) .	70,000			70,000					
New Mexico (Bul. 18) .	56,600			56,600					
Washington, D. C., 1902 .					15,440			15,440	7.72

FEEDING VALUE.

Aside from the question of economic production, the feeding value of any forage crop depends largely on its palatability, nutritive character, and the digestibility of its nutrients.

The palatability of pearl millet to farm animals seems to be thoroughly assured. Its nutritive value, so far as it can be estimated from chemical analyses, is indicated in the following table, where are shown several different analyses of the plant in different stages of growth. For comparison, the averages of a large number of analyses of green and cured corn fodder, corn stover, and green sorghum are also given. Few if any digestive experiments with pearl millet have been carried on, so far as known.

Composition of pearl millet as compared with similar forage plants.

Where recorded.	Air-dry substance.			Water-free substance.				
	Remarks.	Water.	Total dry matter.	Ash.	Crude protein.	Crude fiber.	Nitrogen-free extract.	Ether extract.
PEARL MILLET.								
North Carolina Bul. 73 .		<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>
Georgia Bul. 13 .	Cut in bloom .	14.00	86.00	6.72	8.53	38.72	39.23	1.79
Do .	Cut in dough stage .	39.80	60.20	6.72	4.94	39.70	44.53	4.11
Do .	Stalk and ripe seed head .	25.60	74.40	5.82	5.80	38.65	46.58	3.15
New Mexico Bul. 17 .	Stover, field cured .	7.10	92.90	11.33	1.50	41.98	44.24	.96
Massachusetts Rpt., 1855 .	Cured forage .	8.10	91.90	7.10	8.10	34.30	49.60	.90
Do .	do .	7.80	92.20	6.70	7.90	34.30	49.60	1.50
INDIAN CORN.								
U. S. Dept. Agr., Office Expt. Sta. Bul. 11 .	Cured stover (90 analyses) .	40.13	59.87	5.70	6.40	33.00	53.20	1.70
Do .	Cured fodder (50 analyses) .	42.18	57.82	4.60	7.80	24.70	60.10	2.80
SORGHUM.								
Do .	Green fodder (11 analyses) .	79.40	20.60	5.30	6.50	29.70	56.20	2.30

The great succulence of pearl-millet fodder in the green state is evident from the percentage of water it contains—75 to 80 per cent. The amount of water remaining in the fodder where cured under field conditions is very variable, as many experimenters have noted. In corn the average is about 40 per cent and in pearl millet it is probably about the same, though the range is at least from 10 to 50 per cent. The nitrogen content of these three forage crops does not appear to be very different, but the amount of fiber in pearl millet is much larger than in either of the others, and the nitrogen-free extract is correspondingly lower. Crude fiber is itself less digestible than the other constituents of plants, and, where a large percentage of it is present, it prevents all the others from being digested as readily as usual. Pearl millet can not, therefore, be regarded as quite so valuable for feeding as corn or sorghum on account of this higher percentage of fiber. This is especially true when it is allowed to grow to its full height before being cut, for the amount of fiber increases as the plant grows older and makes the mature stems very woody.

PEARL MILLET AS A SOILING CROP.

Pearl millet is best known as a soiling crop, and it is probably in this capacity that it will always have its chief value. Its rapidity of growth, palatability, quick starting when cut, and great yield are the important features which make it so valuable for this purpose.

The statement has long been current that from four to eight cuttings can be secured each season from pearl millet. This might be true in the rich alluvium of such States as Mississippi and Louisiana if anywhere, but no authentic records of any such forage production as would be indicated by eight cuttings in any locality have been discovered. Six full cuttings are probably the maximum under favorable conditions, and two or three are more nearly the average. The number of cuttings obtained will of course be largest in the richest soil and at the farthest southern latitude where the growing season is longest. The number of cuttings and the yield per cutting will be less with poorer soil or at points farther north where the growing season is successively shorter.

For soiling purposes it is best to cut pearl millet when it reaches a height of from 3 to 4 feet. At this stage it is not only very well relished by cattle and horses, but it starts again most readily from the cut stems. It should always be cut some 4 or 5 inches above the ground, as this gives it a better opportunity for sprouting again very quickly at the lower joints.

In ordinary practice a comparatively small area will be found suffi-

cient for the continuous soiling of a few cows or horses. On plantations in the Gulf States patches of one-eighth to one-fourth acre are common.

PEARL MILLET FOR ENSILAGE.

This crop was recommended for ensilage by the North Carolina and the Georgia experiment stations some years ago, but no use of it for this purpose is recorded. It can be as readily handled as corn or sorghum, and is nutritious and palatable when cut for green forage when it is only from 2 to 4 feet high; but, as it grows taller and approaches the flowering stage, when it would be cut for silage, it becomes woody, and consequently of less feeding value. This is probably the chief objection to its use in the silo. Here, too, its advantage of greater yield over corn and the sorghums would be lost. This advantage is gained through its rapid sprouting out after being cut while young. If cut when about to flower, as it is when used for silage, it is too old to sprout again readily, and hence but one cutting is usually secured, which much reduces the otherwise large yield.

PEARL MILLET FOR HAY.

The greatest obstacle in the way of using pearl millet as a hay crop is the difficulty of properly curing so large a mass of succulent forage. As already stated, it should be planted much more thickly where it is intended for hay than where it is to be used as a soiling crop, in order to keep the stalks slender. It is said to be impossible to cure the hay from an ordinary yield on the ground on which it has grown. But such yields occur only under the most favorable conditions and would not trouble the average grower of pearl millet in the North. A greater difficulty is presented in the extreme succulence of the plants. The analyses show three-fourths or nearly four-fifths of the green plant to be water. The difficulty of curing this into hay can be appreciated. Where it is grown, as is the common custom, in small areas, it can best be handled in the same way as corn fodder, being cut either by hand or with a corn harvester and bound into small bundles and shocked.

To make the best quality of hay it should be cut just as the heads are appearing. As it matures it becomes more and more woody and less valuable for forage. The stover, after seed has matured, is of very little value. Some farmers run the stalks through a fodder cutter, thus securing better results in feeding.

FARMERS' BULLETINS.

The following is a list of the Farmers' Bulletins available for distribution, showing the number, title, and size in pages of each. Copies will be sent to any address on application to any Senator, Representative, or Delegate in Congress, or to the Secretary of Agriculture, Washington, D. C. The missing numbers have been discontinued, being superseded by later bulletins.

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22. The Feeding of Farm Animals. Pp. 32.
24. Hog Cholera and Swine Plague. Pp. 16.
25. Peanuts: Culture and Uses. Pp. 24.
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