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Introducing Beema Bamboo

Beema bamboo is a fast growing, dense, thornless and thick-walled sterile variety well suited as a power generation biomass feedstock.



Origin

Beema bamboo (*Bambusa Balcooa*) is developed from the open pollinated population of bamboo found in West Bengal, followed by further selection and tissue culture work to improve and stabilize its yield and made the plant free from disease. The Beema Bamboo plant is not genetically modified organism and it is a product of conventional breeding which no way involved in gene modification.

Location

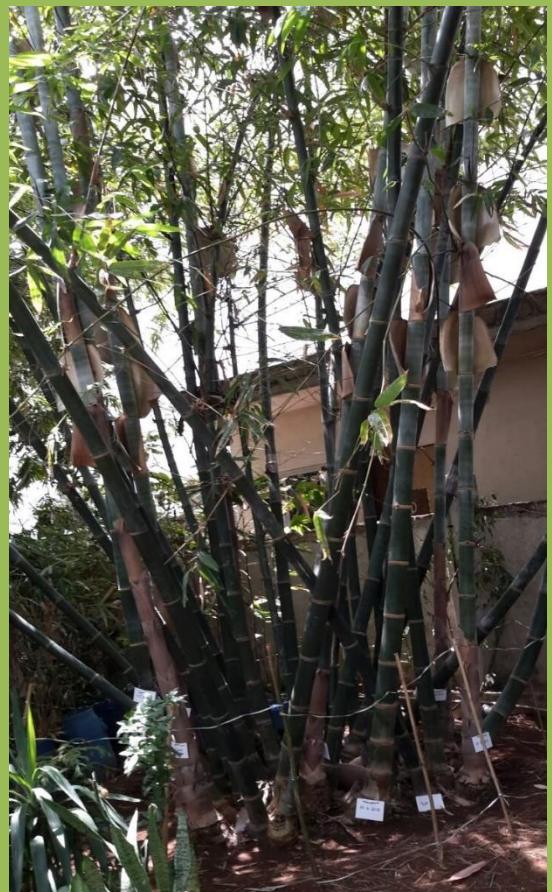
Beema bamboo is ideal for Asia. Being a tropical and sub-tropical species, better growth happens under high light intensity (10 to 14 hours of sunlight daily) with humidity more than 50%. Temperature should be above 10 degree C and not more than 45°C.

Climate

Bamboo can be grown in a wide range of environments, requiring well distributed rainfall, with shortfalls being made up through irrigation. Although bamboos are hardy, adaptable and perennial, they are intolerant to waterlogged condition.

Soil Conditions

Beema bamboo can grow in all types of soil, but preferably in light, loamy, red or sandy loam soil. Beema Bamboo needs 2 feet soil depth and the ideal pH is between 5 to 6.5, however it can be made to grow in up to 8 pH.



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Water Conditions

The water requirement is similar to sugarcane which is 2000mm/annum. The water requirement for bamboo would be 10 to 20 L per plant per day.



No. of plants / ac: 1000 plants/ac

Spacing

8 - 12 x 4 feet between rows alternated by 12 feet within row. The plants are planted at a distance of 4 feet.

Season & Planting

The best planting time is usually as soon as monsoon starts. This gives the plant, a longer growing season to get established and develop its roots to withstand the hot summer season

Land Preparation

The land should be ploughed as thoroughly and deeply as possible. Clearing and ploughing should be done at least three weeks ahead of the planting. Addition of organic materials to pits such as compost, green manures and neutralized saw dust helps retain moisture and also provide nutrition to the plants. Provide better drainage system. Bamboo likes water and requires similarly to sugarcane cultivation to do its best, but it does not like to be submerged in water or “wet feet” condition.

PITS

Pit sites should be identified before digging the pits, to ensure the desired spacing. Dig the pit 2 x 2 x 2 feet size or make continuous trench at 2 feet depth along the row. Pits should be dug much before the rainy season and the dug out pit exposed to

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weathering. A few days before planting fill the pit with thoroughly mixed soil and compost.

Intense Cultivation

Beema bamboo can be cultivated at 2500 plants per hectare similar to sugarcane cultivation with a spacing of 3m between rows and 1.2m between plants. The best suited irrigation is by drip along with fertigation system to supply required fertilizer to the plants. The general requirement of fertilizer is 400:100:440 N:P:K per ha/year. The ultimate requirement of fertilizer and water would be decided based on the site condition, soil condition and water quality and rain fall pattern of the particular place. The recommended cultivation practice for Beema bamboo is “Precision farming” which involves application of required nutrient and water at the appropriate time and at the appropriate zone as per the requirement of the plant.

Plantation Size

The smallest economic plantation size should be about 80 hectares, with an ideal size between 200-500 hectares. Planning to final execution could span 6 to 12 months for 500 hectares depending on a number of variables. The first year would require about 250 man days per ha/yr, reducing to 100 man days/ha during the 2nd and 3rd years. During full harvest time the manpower will increase to 100 man days/ha.

Plantation Output

The harvest of the Beema bamboo starts after 2 years (24 months). By then the bamboo would have grown to a size of 7.5cm at the bottom and 3.5cm at the top with a height of 4.5-6m, and each culm weighing 6-10 kg dry weight. Under ideal conditions each plant has 6 poles, amounting to 7kg of dry biomass weight



at 10-12% moisture for each pole. Therefore one hectare under ideal condition would produce 7kg x 6poles/plant x 2500 plants for a total of 105 tonnes/ha. By the 6th year this output would rise to a maximum of 160 tonnes per hectare, which would be a steady output for over a hundred years.

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Fuel Character

Calorific value : Average 4000 k.cal./kg.

Ash content : 1%

Bulk density : 0.4

Sulphur content: Nil

Biomass Energy Production

A 1MW plant would require approximately 80 ha of Beema bamboo cultivation area to maintain a continuous supply of Biomass feedstock.

Carbon Sequestration

One mature Beema Bamboo will absorb maximum 500kg of carbon dioxide per year. At full maturity, after the 5th year onwards, each ha under intensive cultivation would sequestre 175 to 200 tonnes (metric) of CO₂ per year. If the bamboo was gasified under pyrolysis, it would generate 16 to 19 tonnes of biochar / hectare, which if applied to the soil would further qualifies for additional carbon credit where the carbon remains virtually permanent manner, while improving crop yield and soil quality.

Beema Bamboo Energy Plantation of one years old .



One year Plantation

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Bheema Bamboo

Special character	:	Fast Growing ,High biomass, Thornless Thick walled, Non-flowering
No. of plants per acre	:	1000 nos.
Spacing	:	10 ft. x 3.6 ft
Recommended irrigation	:	Drip irrigation with fertigation
Cost of cultivation	:	Rs.90,000 to 100,000 for the first 2 years Rs.17000 to 19,000 every year after 2 years
Average Yield under good Management practice -		
3 rd Year	:	25 – 30 tonnes per acre per year
4 th year	:	40 – 50 tonnes per acre per year
5 th year	:	50 – 60 tonnes per acre per year
6 th year	:	60 – 65 tonnes per acre per year
7 th year	:	65 tonnes & above per acre per year - continuously for over 100 years
Suitable application	:	Biomass for power projects Paper Industries Fiber for yarn and plastic
recommended for shortage	:	Large Scale plantation Farms & places experiencing labour Absent Landlords Under assured irrigation and fertilizer
Amount of Carbon-di-oxide Absorbed	:	80 tonnes per acre per year
Water requirement	:	2000mm, including rain water (similar to sugarcane)

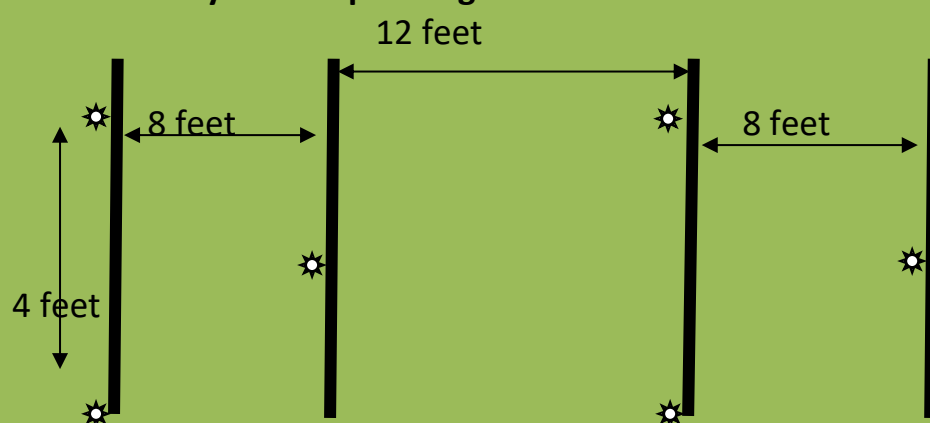
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The above performance of bamboo is under irrigated condition with adequate fertilizer and good Management practice at the farm level. The performance and the yield are as per our experience in our farm and it is likely to increase or decrease depending on the weather in the specific location and Agricultural Management Practice followed.

Recommended for intensive farming, high investment with quick returns, precision farming and for assured return on investment from non-perishable Agri product.

PLANTING DIAGRAM FOR BAMBOO UNDER INTENSIVE FARMING USING 1000 PLANTS/ ACRE:

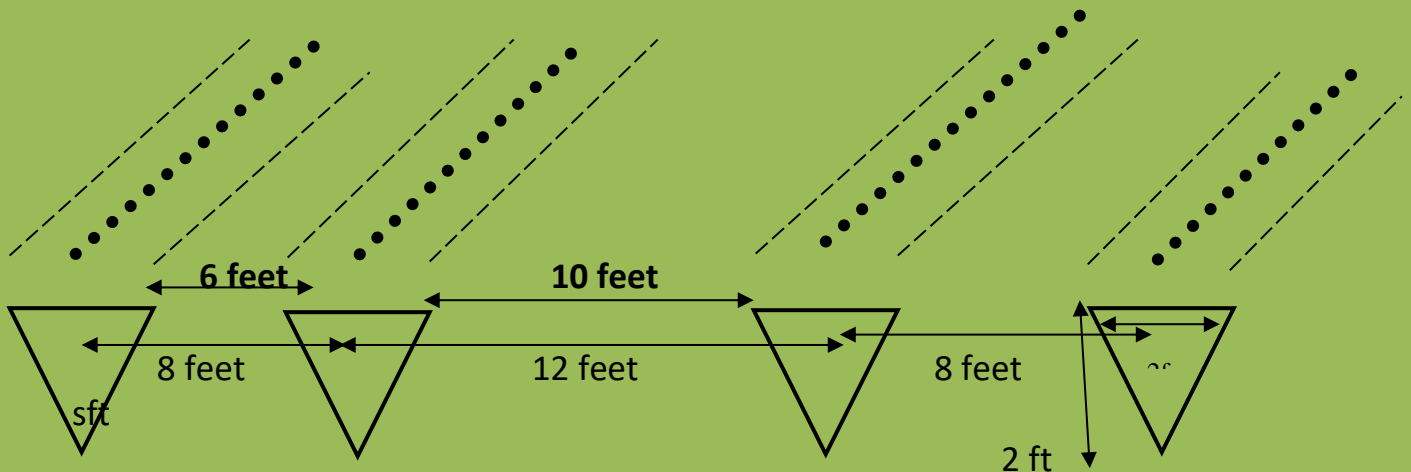
Paired row system of planting:




8' x 4' and 12' x 4' alternatively in a paired row

Note: ✱ - Bamboo plants
 ■ - Drip line

Trenching diagram:



Note:  - Drip lines. Trench size is 2 x 2 feet in triangular shape

Pitting is recommended for soil which is very hard and no cultivation is undertaken before. In loose soil or the field where cultivation is undertaken previously, trenching is recommended.

PLANTING

In the pit, mix the soil with 2 baskets (20 to 25 kgs) of FYM and 500gms of neemcake. If the place is prone to termite increase the neem cake to 1 kg as basal application. In case of long trench apply the above mixture along the trench. Carefully cut open the Polybag having the bamboo plants using sharp blade, to ensure the root ball not disturbed. Place the plant vertically in the pit, ensuring that entire polybag soil is placed along with plants. Level the pit or trench with the mixed and enriched soil, be sure to eliminate all air pockets. Mulch the soil around the plants, it will help control weeds and keep the soil moist.

IRRIGATION

Provide life irrigation immediately after planting with 10 to 15 lit of water. Drip irrigation along with fertigation tank is one of the good irrigation systems to get maximum yield. Irrigate after planting depending on the soil condition and prevailing climatic condition. Compact the loose soil around the plant. Repeat the irrigation at an interval of 2 to 3 days for the first one month. The water requirement for bamboo for the first month will be 2 to 3 lit per plant, at the end of first year it will increase to 8 to 10 lit a plant. When the plants are fully

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grown the water requirement would be 20 lit per plant during peak summer. The frequency of watering depends on how soon the bamboo is showing the symptom of wilting. The typical wilting symptom of bamboo appears as folding of leaf blade followed by total curling.

FERTILIZER APPLICATION

Bamboo plants are heavy feeders and respond very well to fertilizers. Growth of bamboo is vigorous under fertilized condition than without. Fertilizers are important to ensure high yield and overall profitability of plantations. Bamboo needs complete range of fertilization including nitrogen, phosphorous and potassium and often a higher amount of potash. It is better to carry out soil analysis to fix and confirm the dosages. A general dosage norm that may be followed is 870 kgs of Urea, 500 kgs of SSP and 900 kgs of MOP per acre per year. For the first year 50%, second year 75% and third year onwards-full dose should be given in 10 split doses. Care should be taken to see that chemical fertilizers are not applied close to the plant and should be applied 12 inches away from the plant during first year and 2 feet away from plant during second year onwards.

SOIL LOOSENING

Soil should be loosened to a depth of 10 – 15 centimeters, and 30 –45 centimeters away from the bamboo clump at least twice a year, improves the growth of shoot and the root system. Preferably ploughing with tractor in between the rows of bamboo before the rains would absorb the rain water better. Intercultivation operations between rows also remove weeds. It is possible to do the Intercultivation by tractor for the first 1 or 2 years between all rows of bamboo, later it would be possible in the wider rows with 12 feet gap.

WEEDING

Regular weeding is necessary 1 foot surrounding the plant to prevent weeds and other vegetation from competing with the young bamboo plants for sustenance. Weeding should be done at least for the first two years after the rains and end of the wet season. Once the clump gets established there is considerable leaf coverage and shedding and this act as a barrier to the emerging weeds. Weeding should be done very carefully at the time of new shoot emergence, which mostly coincides with pre monsoon time.

MULCHING

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Mulching reduces loss of moisture due to evaporation from the soil surrounding plant and checks weed growth. In grownup bamboo field, fallen bamboo leaves serve as good on-site mulching material.

MOUNDING

Rhizomes grow laterally under the soil surface and when ready to produce new shoots, begin to grow upward. In this period of growth, exposure to sunlight retards and may even stop the growth of rhizomes. Mounding or heaping fresh, loose soil around and over the base of the plant is recommended.

PRUNING

There will be heavy branching at the lower nodes of the plant. In the first two years Pruning of these branches reduces clump congestion and helps provide a healthy, airy environment within the clump. Mild pruning should be done in the second year especially 12 feet wide row. It should be completed before the end of the dormancy period, well before shoots emerge.

CLEANING

Generally clump formation starts in second year, the management of clump are very important. Rhizomes grow centrifugal (outwards) throwing up new shoots in enlarging circular formation. Bamboos can throw up many branches, which if left unattended can get deeply entangled. This not only curbs access to older culms towards the center of culm, but also obstructs free vertical growth of new culms. The new culms may get twisted and turned, which further congest the clump. Such malformed culms make harvesting of the better culms difficult. Therefore, it is important to clean clumps early and to remove all dead and malformed culms. A well aired clump results in the emergence and growth of healthy culms. Dead stems are vulnerable to pathogens.

A good time to carry out clump cleaning operations is throughout the year other than new shoot formation period.

THINNING

In the energy plantation with high density population, the clump formation should be along the row or towards the 8 feet row. The shoot formation towards the 12 feet row should be discouraged. The clump structure would become oval shape from the planting point. Two nearby clumps would meet in 4 to 5 years time making a continuous row of bamboo culms. Weak and deformed culms should not be retained in the clump.

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HARVESTING

One year old culms are harvested from second year onwards. Harvesting is done on an annual basis with an interval of 12 months. Harvesting of bamboo culms every year will induce the emergence of new shoots and ensures regular and healthy culm production. Harvesting of bamboo for commercial purpose can begin from the second year of establishment of plantation. The yield of bamboo increases every year by 10 to 20 % and stabilizes after 5 years.

The best time of the year to harvest culm is the post monsoon season extending through the summer. Culms should not be harvested in the growing season, which is normally during the monsoon months. Harvesting in this period can damage young and emerging shoots and retard the growth of the clump.

HARVESTING TIPS

- ✓ The number of harvested mature culms should not normally exceed the number of healthy shoots that sprouted and grew into young culms in the preceding year.
- ✓ Stunted and diseased shoots should be removed from the clump as soon as they are identified.
- ✓ The clump should be visually examined and the culms to be harvested are selected, before beginning the cutting operations.
- ✓ Branches extending from the lower nodes of the selected culms should be removed. This makes cutting and extraction easier.
- ✓ The culm should be harvested at least one, preferably two nodes, above the ground. This reduces the risk of injuring the rhizome.
- ✓ The culm should be cut obliquely, that is, with a slanted cut. This ensures that rain water, debris and twigs do not collect in the uncut portion above the last remaining node, and become a breeding ground for fungus, parasites and insects.

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PROJECT COST BRAKEUP FOR CULTIVATON OF BEEMA BAMBOO UNDER PRECESSION FARMING BY FARMER IN 5 ACRES OF OWN LAND

YEAR/PROJECT COST BREAKUP	(Rs. IN LAKHS)										TOTAL
	YR-1	YR-2	YR-3	YR-4	YR-5	YR-6	YR-7	YR-8	YR-9	YR-10	
LAND	-										-
LAND DEVELOPMENT, WATER HARVESTING AND FENCING	0.13										0.13
Well AND PUMP	-										-
FERTIGATION & IRRIGATION SYSTEM	1.15										1.15
COST OF PLANTS	1.30	0.05									1.35
PLANTATION ESTABLISHMENT COST	2.38	1.09									3.48
PLANTATION MAINTANCE COST	-	0.00	1.16	1.31	1.38	1.38	1.38	1.38	1.38	1.38	10.78
TOTAL COST Rs Lakhs	4.96	1.15	1.16	1.31	1.38	1.38	1.38	1.38	1.38	1.38	16.88

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COST OF CULTIVATON OF ONE ACRE BAMBOO UNDER PRECESSION FARMING BY FARMER

Sl.No	Items	VALUES IN Rs							
		I year	II year	III year	IV year	V year	VI year	VII year	Total
1	Ploughing (Ist year - 3 times)	1,000	-	-	-	-	-	-	1,000
2	Digging of pits	13,000							13,000
3	Ploughing for Weed Removal	500	400	300	300	300	300	300	1,300
4	Planting Material	25,000	2,500	-	-	-	-	-	27,500
5	Cost of transport	1,000	40						1,040
6	Mortality Replacement in II year	-	1,000	-	-	-	-	-	1,000
7	Farm yard Manures	15,000	3,750	0	0	0	0	0	18,750
8	Fertilizers	6,735	11,225	11,225	11,225	11,225	11,225	11,225	51,634
9	Plant Protection	1,000	1,000	1,000	1,000	1,000	1,000	1,000	5,000
10	Irrigation	300	300	300	300	300	300	300	1,500
11	Drip system	23,000	500	500	500	500	500	500	25,000
12	Inter cultivation cost / harvesting cost	0		8,100	11,025	12,600	12,600	12,600	31,725
13	farm management cost	-	-	-	-	-	-	-	0
14	on farm tech.consultancy	-	-	-	-	-	-	-	0
SUB TOTAL		86,535	20,715	21,425	24,350	25,925	25,925	25,925	1,78,449

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MANDAYS AND THEIR COST FOR BAMBOO CULTIVATION PER AC

SNO	Items	Mandays	I year	II year	III year	IV year	V year	VI year	VII year	Total
1	Land Preparation	5	875							875
2	Refilling of pits	15	2,625							2,625
3	Planting & Staking	8	1,400							1,400
4	Plant Protection / year	3	525	525	525	525	525	525	525	2,625
5	Weeding	18	2,100	1,050	-	-	-	-	-	3,150
6	Pruning	5	875	875	-	-	-	-	-	1,750
7	Soil working & others	10	1,750	1,750	1,750	1,750	1,750	1,750	1,750	8,750
8	Harvesting during -3rd year on wards	0	-	-	0	0	0	0	0	0
SUB TOTAL			10,150	4,200	2,275	2,275	2,275	2,275	2,275	21,175
GRAND TOTAL		64	96,685	24,915	23,700	26,625	28,200	28,200	28,200	1,99,624

Spacing : 3 X 1.3 (Meters)

Plant Population : 1000 NOS

Country: Tropical Parts of India

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STATEMENT OF NET INCOME

	1st year	2nd year	3rd year	4th year	5 th to 14th year	Total
Total Exp -Rs.	4,95,924	1,14,573	1,15,998	1,30,623	1,38,498	23,80,602
Total Yield -Tons	0.0	0.0	162.0	220.5	252.0	3,154.5
Total Income -RS.	0	0	3,72,600	5,07,150	5,79,600	72,55,350
Net Income -RS.	4,95,924	1,14,573	2,56,602	3,76,527	4,41,102	48,74,748



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