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Biofertilizer Technology for Spices




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Background

Biofertilizers are defined as preparations containing living cells or latent cells of efficient strain of microorganisms that help crop plants in uptake of nutrients by their interactions in the rhizosphere, when applied through seed or soil. They accelerate certain microbial processes in the soil which augment the extent of availability of nutrients in a form easily assimilated by plants.Biofertilizer enhances nutrient availability and its efficiency, which results in improved growth and yield of spice crops.The biofertilizers are ecofriendly, cost-effective and organic-based inputs,which not only maintains soil health but also improves the growth and yield of spices.Hence, to popularize the biofertilizers in spices, novel nitrogenous biofertilizers viz; *Microbacterium, Cellulosimicrobium, Paenibacillus* and *Azospirillum zeae* were mass produced and distributed to the spice farmers of Wayanad district in Kerala under AINP on Soil Biodiversity-Biofertilizers, KAU, Thrissur Centre.The main objectives were to popularize native biofertilizers for spices so as to improve the growth of black pepper and ginger.

Major Spices of Kerala (2019-2020)

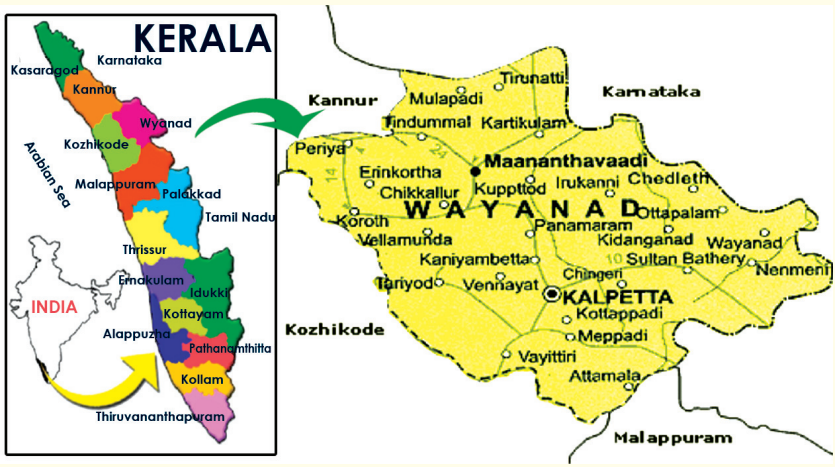
Major Spices of Kerala	Cultivated area (ha)	Production (tons per year)
1. Ginger	4265	83940
2. Nutmeg	22510	14340
3. Black pepper	82540	20,000
4. Small Cardamum	39697	10074
5. Clove	1039	70

Source: https://www.indiastat.com/table/agriculture-data/2/horticulture/118/1116676/data.aspx

Wayanad district is located in the southern tip of the Deccan Plateau and forms a part of the Western Ghats. The tribals form about 17% of the total population of the district and 36% of the tribal population of the state. The region mainly consists of the Paniyars, the Kurumas, the Adiyas, the Kurichyas, the Ooralis, the Kadans, and the Kattunaikkans. Agriculture is the main source of livelihood and 95% population is engaged in agriculture. Suitable climate and soil fertility makes the district a favourite place for farmers. Crops cultivated in Wayand includes spices such as black pepper, ginger and cardamom. Pepper is largely grown along with coffee in the north eastern parts of the district. Ginger cultivation in Wayanad has also substantially increased and is mainly marketed in the form of green ginger.

Excessive use of pesticides and chemical fertilizers have destroyed the fertility of cultivable lands. The fertility of the soil and suitable climate for

cultivation made the place a favorite for the farmers. But since 2000, the agricultural sector is facing a severe crisis due to depletion in soil fertility and climatic change. Steadily growing public concerns about pesticides, food safety, environmental quality, groundwater contamination, dependency on fossil fuels and soil and water conservation have led many farmers and the government to consider alternative means of agricultural production mainly through organic farming. The relevance of biofertilizer increases as state aims at 100% organic farming. Organic products fetch a high income for the farmer and hence the use of biofertilizers will improve the standard of living of tribals in Wayanad district. In this context, the present project on 'Exploitation of soil biodiversity for popularization of biofertilizers in the tribal areas of Wayanad District' was taken up under the ICAR-All India Network Project on Soil Biodiversity and Biofertilizers (AINP-SBB).



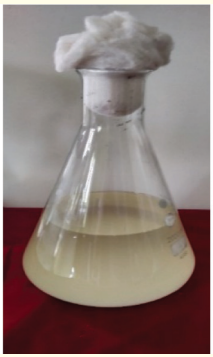
Mass production of biofertilizers

Step 1: *Mass culturing of microorganisms*

- Jenson's broth (100 ml) for *Microbacterium, Cellulosimicrobium, Paenibacillus* and Okon's broth (100 ml) for *Azospirillum zea* are prepared in flasks (250 ml capacity) and inoculated with respective mother culture.
- Microorganisms are grown under shaking conditions at 30±2°C
- Culture is incubated until maximum cell population of 10^{10} to 10^{11}cfu/ml is obtained.
- Under optimum conditions, population level could be attained in 5 to 7 days for *Microbacterium, Cellulosimicrobium, Paenibacillus* and *Azospirillum zeae*.

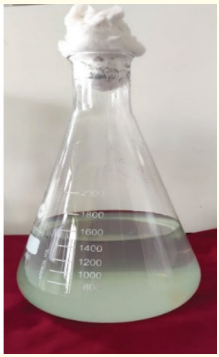
- The culture obtained in the flask is called **starter culture**.
- Microbial inoculum from starter culture is again transferred to large flasks/seed tank fermenter and grown until 10^{10} to 10^{11}cfu/ml is obtained,

Inoculated Jenson's Broth (100 ml) as starter culture for *Microbacterium*, *Cellulosimicrobium* and *Paenibacillus* mass production



Jenson's broth in conical flask (1.5 litre)- Seed tank flask

Inoculated Okon's Broth (100 ml) as starter culture for *Azospirillum* sp. mass production



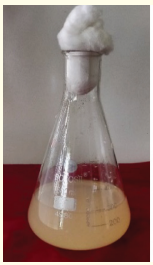
Okon's broth in conical flask (1.5 litre)- Seed tank flask

Step 2: ***Processing of carrier material***

- Carrier material (talc-mineral form) is purchased from the local market in a powder form.
- Sieved and unsterilized talc powder is used as carrier material for biofertilizer

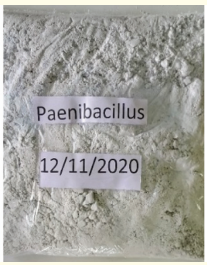
Step 3: ***Mixing with carrier material***

- Microbial inoculum is mixed with the carrier material at the rate of 300 ml inoculated broth with 1 kg of talc. The moisture percent should be 8-12%.
- The packet should be kept in a cool place which is away from the heat or direct sunlight.
- The packets may be stored at room temperature or in cold storage conditions in plastic crates or polythene / gunny bags.
- The population of the inoculant packet has to be determined at 15 days interval. There should be more than 10^{8}cfu/ g of inoculant at the time of preparation and 10^{7}cfu/ g on dry weight basis before the expiry date.



300 ml Inoculum

Mixing the inoculum with talc powder



Biofertilizers packet

Application of biofertilizers in spices

Soil application: It is applied after mixing with dried FYM or compost or vermicompost at the rate of 1:25 (w/w).

Black pepper: *Microbacterium* or *Cellulosimicrobium* or *Paenibacillus* sp. or *Azospirillum zeae* : 20 g /vine at bimonthly interval

Ginger: *Paenibacillus* sp. : 20 g / bed of 3 x 1 m at bimonthly interval

Effect of biofertilizer on the growth of black pepper in Wayanad district

Effect of biofertilizer on the growth of Ginger in Wayanad district

Effect of microbial inoculants on growth and yield of black pepper in Wayanad

Treatment	No. of laterals (per 0.5 m^2)	Pedicel length (cm)	Yield (Kg / plant)	1000 berry weight (g)	1000 berry volume (ml)	Increase in yield over control (%)
Azospirillum	17.03^{bc}	1.33^{ab}	5.43^{a}	387.67^{a}	28.77^{a}	21.23
Microbacterium	19.0^{a}	1.32^{ab}	5.65^{a}	402.0^{a}	30.03^{a}	26.54
Cellulosimicrobium	18.27^{ab}	1.37^{a}	5.23^{a}	389.33^{a}	28.93^{a}	21.91
Paenibacillus	18.37^{a}	1.30^{b}	5.46^{a}	296.75^{a}	28.07^{a}	18.28
Control	16.83^{c}	1.24^{c}	4.34^{b}	337.33^{b}	23.73^{b}	
CD (0.05)	1.284	0.062	0.829	33.649	3.23	

Effect of different microbial inoculants on growth and yield of ginger in Wayanad

Treatments	No of tillers	No of leaves	Plant height (cm)	Yield (t/ha)	Increase in yield over control (%)
Azospirillum	15.333 [b]	16.167 [b]	82.950 [a]	12.600 [c]	14.5
Microbacterium	15.467 [b]	15.100 [c]	82.193 [a]	14.200 [b]	29.0
Cellulosimicrobium	15.333 [b]	15.333 [c]	81.977 [a]	14.033 [b]	27.3
Paenibacillus	16.367 [a]	16.867 [a]	82.110 [a]	16.567 [a]	50.0
Control	13.300 [c]	14.267 [d]	75.797 [b]	11.000 [d]	
CD(0.05)	0.632	0.543	2.344	0.872	

Cost of biofertilizer production (Without building structure): *Microbacterium* or *Cellulosimicrobium* or *Paenibacillus* sp. and *Azospirillum zeae*: Rs. 65 / kg

Technology transfer and impact

Parameters	2015-'16	2016-'17	2017-'18	2018-'19	2019-'20
No of farmers benefitted	300	1398	389	1205	1395
No of trainings organized	111	205	191	168	302
No of FLDs conducted	4	4	3	3	4

Revenue biofertilizer marketed/ distributed

Biofertilizers worth of Rs. 97,810 distributed to the tribal farmers of Wayanad during 2017 to 2020

Training class at Vythiri, Wayanad district

Demo at choothppara, Wayanad district

Distribution at Kollagappara panchayath, Wayanad district

Prepared by

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