



# The Application of Plant Growth Promoting Rhizobacteria Technology to Increase Peanut Production in Poor Farmers "Sumber Hidup" Farmer Group of Sigerongan Village

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**Abstract:** Some members of "Sumber Hidup" farmer group were poor farmers, farming on narrow land with low productivity. The aim of this activity was to help farmer group through the application of Plant Growth Promoting Rhizobacteria (PGPR) technology to increase peanut production on narrow land. These activities have been carried out to apply science and technology, as direct training/counseling and plot demonstrations (action research) to farmers. The method used in training was adult education with participatory techniques. Training and plot demonstration activities aimed to increase the skills and knowledge of farmers. The demonstration plot that has been carried out was in the form of action research based on the results of previous research. The demonstration plot that carried out was to compare the planting of several peanut lines using PGPR. The results of the activity showed that members of the "Sumber Hidup" farmer group were very responsive to community service activities. Farmers heard and asked the several questions related to planting superior varieties and implementing PGPR. Participants were very active in every activity such as selecting seeds, making plot demonstration, planting, hilling, weeding and harvesting activities. The technological transformation process for the use of superior varieties and the application of PGPR on narrow land has occurred in the "Sumber Hidup" farmer group. The results of the plot demonstration showed that the application of PGPR on the G19-UI groundnut line produce 3,280 g of dry pods/plot or the equivalent of 8 tonnes/hectare.

**Keywords:** Farmer partisipative; Plot demonstration; Plant growth promoting rhizobacteria

## Introduction

Sigerongan Village, Lingsar District, is one of the development areas for peanut and vegetable on the Lombok island. This village has an area of 470 Ha with a population 6,198 people with a population density of 1,319 people/Km<sup>2</sup>. Most of the population works in the agricultural sector both as farmers and livestock breeders, especially as sharecroppers and farm laborers. This village has an agricultural area consisting of technical (225 Ha), semi-technical (32 Ha), and non-

technical (10%) irrigated rice fields. This village is one of the agricultural areas that receives technical irrigation, the flat land and hilly. The livelihood of the majority of the population (85%) is farming and most of it is done on a narrow land (5-10 acres) and the majority of farmers are sharecroppers and farm laborers with a low farmer income (poor) (Kecamatan Lingsar Dalam Angka, 2021; Susilowati and Maulana, 2012).

To increase the development of farming at the farmer level, farmer group have been formed. One of the farmer group in Sigerongan village is "Sumber Hidup".

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This farmer group mostly carries out farming in technically irrigated rice fields. The farming businesses being developed include rice, peanuts and vegetables.

Peanuts have high economic value, as a source of vegetable protein which is quite important in the diet, and as a feed ingredient. Most peanut planting (70-80%) is carried out at the beginning of the dry season or at the end of the rainy season. The development of peanuts often into problems because the plants are subjected to drought stress, which causes pod production to be hampered and even crop failure. Peanut planting in Sigerongan village is still done simply without applying standard cultivation technology. Peanut farming is generally carried out by small farmers with very low capital and application of technology. Developing peanuts in irrigated rice fields is difficult because they have to compete with other more economical food crops such as rice, corn and soybeans.

The results of initial observations in the field showed that the average peanut production at the farmer level was < 1,0 ton of wet pods and is still very low compared to the national variety production of 3-4 tonnes of wet pods. Low production causes peanut farmers' income to be low, which has an impact on the poverty of members of farming groups. The initial survey results also showed that the potential that can be developed for small land farming businesses in Sigerongan village was increasing the intensification of small land through the application of cultivation technology such as the application of Plant Growth Promoting Rhizobacteria (PGPR) and superior varieties. PGPR is a type of biological fertilizer that is used as a liquid fertilizer so that it is easily absorbed by plant roots (Dey et al., 2004). PGPR is a bacterial consortium that actively colonizes plant roots which plays an important role in increasing plant growth, crop yields and land fertility (Munees and Mulugeta, 2014). The "Sumber Hidup" farming group is not yet accustomed to using PGPR for peanut farming. Therefore, community service activities for this farmer group will increase their knowledge of carrying out peanut farming by applying PGPR technology. Plant Growth Promoting Rhizobacteria (PGPR) is a group of bacteria that can colonize an area of 1-2 cm around plant roots (rhizosphere) (Frezarin et al., 2023). This group of bacteria can have a positive impact on plant growth, including providing nutrients (biological fertilizer), producing growth hormones (growth regulators) and having antagonistic properties against plant pests (Nasib, 2016; Febriyanti et al., 2015). Researchers from Reseacher Group have also produced several superior strains of peanuts, so this lecturer's dedicated work will use these superior strains and apply PGPR to increase peanut production and ultimately increase farmer income to help poor farmers.

Apart from that, the research roadmap of the "Research Group: "Genetic Resources Management for Nuts and Horticultural Crops is the development of peanut plant. Several superior varieties and quality peanut seeds collected by Research Group will be used by partner farmers in Sigerongan village. Therefore, this activity aims to help the partner farmer group "Sumber Hidup" in Sigerongan Village to increase peanut production by applying Plant Growth Promoting Rhizobacteria (PGPR) technology and using superior varieties and quality seeds in peanut cultivation in narrow land.

## Method

The implementation method that has been applied to this activity is to help the partner farmer group "Sumber Hidup" in Sigerongan Village to increase the productivity of small areas of land by applying Plant Growth Promoting Rhizobacteria (PGPR) technology in planting peanuts. As a result of increasing peanut productivity, it is hoped that the income of partner families will increase, resulting in a reduction in poverty.

This implementation method is also carried out with achievement indicators:

1. Increased peanut productivity in narrow land after using Plant Growth Promoting Rhizobacteria (PGPR) technology.
2. Increasing partner farmers' understanding of applying Plant Growth Promoting Rhizobacteria (PGPR) technology for peanut cultivation
3. Increasing partner farmers' understanding of using superior varieties and quality peanut seeds on limited land.
4. Coordination was carried out to increase the capacity of farmer groups with PPL, Village Head and other farmer group.
5. There was an increase in farmers' income after implementing Plant Growth Promoting Rhizobacteria (PGPR) technology for peanut cultivation

To successfully implement this community service activity, there were several stages of activity that have been carried out, namely:

1. Preparation. This preparation stage is carried out to prepare proposals and follow-up plans for implementing activities. Preparatory stages include:
  - a. Needs analysis  
Information is collected by means of observation, interviews and following activities carried out by farmers. Data collection includes, among other things, the main problems faced, the condition of the farming community both in terms of

economics, education and their views on new innovations, etc.

b. Analysis of the creation of productive activities

Data collection is carried out simultaneously with activity stage a), covering agricultural resource issues (potential, application of technology, production, etc.) in connection with the creation of productive business activities and the selection of cultivation technology packages to be developed.

c. Program promotion

This activity is an approach and conveys program plans to farmer groups regarding the objectives and benefits of activities, activity plans, program sustainability and its impact on community income levels.

d. Determination of participants

The selected participants are those who have enthusiasm as motivators, mobilizers, facilitators and reformers related to the objectives of the activity. The participants who will be selected consist of: farmer group leader, field agricultural instructor, youth farmer leader, women farmer leaders, local entrepreneurs and active farmer group members.

2. Implementation of Activities. The problem solving that has been carried out in this program is to increase the productivity of small areas of land through the application of Plant Growth Promoting Rhizobacteria (PGPR) technology in peanut cultivation. To increase peanut productivity, it is necessary to apply the science and technology possessed by the Proposing Team in the form of training activities and plot demonstrations (action research). The stages of activities carried out include:

a. Training

The method used in training is the adult education method with participatory techniques. Technical training participants include heads of farmer groups, PPL, youth farmer leaders, women farmer leaders, local entrepreneurs and active farmer group members. Training activities include explanation of the material with lectures, discussions and questions and answers. Training activities will be carried out for 1 (one) day, with training materials, as follows:

- Economic prospects for peanuts
- Peanut cultivation
- Plant Growth Promoting Rhizobacteria (PGPR) cultivation technology for peanuts
- Superior varieties and quality seeds of peanuts
- Harvest and post-harvest peanuts
- Production of quality peanut seeds.

b. Plot demonstration

The demonstration plot that will be carried out is in the form of action research based on the results of the research that has been carried out by the team. The demonstration plot that will be carried out is to compare peanut planting with the application of Plant Growth Promoting Rhizobacteria (PGPR) technology and without PGPR on several peanut varieties.

The superior peanut seeds used came from the Researcher Group collection "Genetic Resources Management for Nuts and Horticultural Crop. After the training was carried out, it was continued with an explanation of the Demonstration Plot. The demonstration plot settings followed a Randomized Block Design (RAK) with treatments comparing peanut planting with the application of Plant Growth Promoting Rhizobacteria (PGPR) technology and without PGPR on several peanut varieties. The treatments demonstrated were:

P0 = without application of Plant Growth Promoting Rhizobacteria (PGPR) on several peanut varieties

P1 = application of PGPR technology to several peanut varieties

The next explanation includes land preparation, plot creation, planting, plant maintenance, and harvesting. Soil processing has been carried out once. After processing, a plot is made. The experimental plot measures 200 x 200 cm. Plant maintenance is carried out on peanut plants. Weeding is carried out while hilling by turning the soil over so that the soil becomes loose. Hounding is only done at the beginning of planting with NPK (15-15-15) at a dose of 100 kg/Ha. Pest and disease control is carried out by spraying insecticides and fungicides. Irrigation is done with irrigation water, which is done the day after planting, 30 days after planting, and 75 days after planting. Peanut harvest is carried out at 90 days after planting. Parameters observed included plant height, number of pods per plant, fresh weight of pods per plot and dry weight of pods per plot.

Analysis of peanut farming businesses using Plant Growth Promoting Rhizobacteria (PGPR) technology is carried out by calculating harvest yields and converting them to prices. If the selling price is higher with capital then it is said that the technology is profitable or can increase the farmer's income. Increasing farmers' income means that they can continuously reduce poverty in this farmer group.

3. Program sustainability. To observe the sustainability of this community service program, monitoring and re-evaluation of farming activities carried out by farmers are carried out. Monitoring and evaluation activities are mainly carried out on farmer behavior,



by observing work ethic and application of farming technology.

- Farmer involvement. Farmers are actively participatory in planning, implementing and evaluating harvest results in training and demonstration plot activities. The Farmer Group is directly involved in the preparation and implementation of training and demonstration plots. Farmers were given an explanation of the purpose of the activity, implementation of the demonstration plot from methods to planting procedures, observing parameters, harvesting and the results of the demonstration plot. Farmers can directly compare several treatments in the demonstration plot and farmers can directly see the harvest results.

## Result and Discussion

The transformation of agricultural technology results in the form of PGPR applications, superior varieties and quality peanut seeds must be utilized by farming communities. The technological transformation methods developed here are training (counseling) and plot demonstrations.

### *Training Activities (Extension)*

The training was carried out to deliver extension material. In order for research results to achieve success in the adoption process, a technology needs to be heard, demonstrated and carried out, so that the implementation of training needs to be continued with practical activities in the plot demonstration. Training was a form of communication media in efforts to develop information in the dissemination of research results (Indraningsih, 2011).

Theoretically, agricultural extension is an effort to change the behavior of farmers so that they have broader knowledge, have a progressive attitude to make changes and be innovative towards new things (information) and are skilled in carrying out various activities that are beneficial for increasing agricultural business productivity, income/profits, and for the welfare of the family and society (Mardikanto, 1996).

This community service activity has been carried out to increase the knowledge and skills of "Sumber Hidup" partner farmers of the Sigerongan Village to utilize narrow land by implementing PGPR on several peanut superior varieties. In this activity, the communication technique used by the extension team was direct extension, namely face to face communication between the extension team and farmers. The direct method is used so that farmers hear and respond directly and quickly to the extension material presented. The extension team delivered educational material at the experimental demonstration plot. According to

Martanegara (1993) that the direct method is considered more effective in convincing and strengthening the relationship between extension teams and farmers as well as quick response or feedback from the target. Figure 1 explains the face-to-face lecture activities between instructors and members of the "Sumber of Life" group.



**Figure 1.** Farmers were following an explanation about the benefits of PGPR and how to apply it to peanuts

The results of the service community activities showed that the extension participants were very responsive to the extension activities. This can be seen from the presence of the participants and the involvement of the participants during the implementation of the counseling. The presence of participants was in line with the target, namely 15 people with the composition of participants consisting of members of the "Sumber Hidup" farmer group, local irrigation leader, community leaders and women farmers. Participants in this extension were deliberately selected directly from farmer groups, because they were considered effective in directly implementing PGPR and peanut cultivation. Judging from the involvement of the participants during the counseling, it turned out that the participants really listened and were directly involved in the questions and answers.

This lecture activity has been carried out to teach about the economic prospects of peanuts, cultivation of peanut plants, superior varieties and quality seeds of peanuts, the benefits and applications of PGPR and harvesting and post-harvesting of peanuts. Farmers were more enthusiastic about practicing by looking at the reality in the field starting from planting, PGPR application to harvesting. Participatory techniques were mainly carried out to hear directly about problems regarding peanut planting and invite farmers to work together to find solutions to increase farming production.

The use of PGPR, superior varieties and quality peanut seeds can guarantee the achievement of maximum production in accordance with its genetic potential (Dey *et al.*, 2004). PGPR is a bacterial consortium that actively colonizes plant roots which plays an important role in increasing plant growth, crop yields and land fertility (Munees and Mulugeta, 2014). Plant Growth Promoting Rhizobacteria (PGPR) is a group of bacteria that can colonize an area of 1-2 cm around plant roots (rhizosphere) (Frezarin *et al.*, 2023). This group of bacteria can have a positive impact on plant growth, including providing nutrients (biological fertilizer), producing growth hormones (growth regulators) and having antagonistic properties against plant pests (Nasib, 2016; Febriyanti *et al.*, 2015).

**Plot Demonstration**

The knowledge and technology produced by researchers needs to be transferred to farmers. Farmers' access to information on technological innovation is relatively limited, so it is necessary to socialize and provide understanding to farmers. Understanding a technological innovation certainly goes through a mental process stage from the individual farmer to making the decision to adopt it (Mardikanto, 1993).

Adoption of PGPR and superior varieties and quality seeds is not enough to be done through lectures or discussions, but needs to be done through direct practice. Plot demonstrations are a form of outreach media carried out through direct practice in the field by comparing farmers' methods and the application of PGPR technology and the use of superior varieties/lines and quality peanut seeds.

The demonstration plot that has been carried out is the application of PGPR to several superior varieties and quality seeds of peanuts. Demonstration plots are an extension method in the field to show/demonstrate in real terms the methods and/or results of applying agricultural technology that has been proven to be profitable for farmers. It is hoped that the adoption of this technology will result in changes in behavior in the form of farmers' knowledge, attitudes and skills after receiving the "innovation" conveyed by the instructors to their targets. Acceptance here means not just "knowing" but actually being able to carry it out or apply it correctly and living it up.

In this activity, after carrying out the theoretical explanation, it is continued with an explanation of the Demonstration Plot. The next explanation includes PGPR application, soil processing, plot creation, planting, plant maintenance, and harvesting (Figure 2).



**Figure 2.** Demonstration plot activities: (A) introduction of PGPR products, (B) planting peanuts (C) growth of peanuts aged 20 days after (D) comparing plant growth due to PGPR (E) harvesting peanuts

In this demonstration plot activity, the Team conducted an experiment by testing the yield of several peanut varieties using PGPR. The experimental land was processed once until smooth and plotted. The

experimental plot was made with a size of 200 x 200 cm. At the time of harvesting, several parameters were also observed such as the dry weight of the pods per plot, the number of pods contained, the dry weight of the plant.



The results of demonstration plot tests for several peanut varieties can be seen in Table 1.

**Table 1.** Demonstration results of yield performance of several peanut varieties with and without PGPR applied (plot area 200 x 200 cm<sup>2</sup>)

Treatment & Variety	Dry pod weight Per plot (g)	Pod number per plant	Plant dry biomass weight up land (g)
Witout use PGPR			
Bison	1830 b <sup>1)</sup>	15.9 a <sup>1)</sup>	24.3 b <sup>1)</sup>
G19-U1	1950 b	15.4 a	18.3c
G300-UII	1513 c	12.6 b	16.9 c
Hypoma-1	1170 d	10.0 c	24.3 b
Pelanduk	1120d	11.7 b	24.3 b
Domba	2010 b	12.5 b	24.3 b
G200-I	1840 b	13.7 b	24.3 b
Use PGPR			
Bison	2093 b	15.6 a	20.5 c
G19-U1	3280 a	16.2 a	27.1 b
G300-UII	1350 d	11.3 b	26.3 b
Hypoma-1	1330 d	11.5 b	23.7 b
Pelanduk	2050 b	17.2 a	24.7 b
Domba	2090 b	16.5 a	34.0 a
G200-I	2140 b	16.3 a	20.9 bc

Note: Numbers followed by the same letter in the same column are not significantly different in the Duncan 5% test

In Table 1, it can be seen that the use of PGPR in several varieties and lines of peanuts generally produces higher dry weight of pods than without the use of PGPR. The G19-UI peanut line with the PGPR application produced the heaviest dry weight of pods, namely 3,280 g per plot or the equivalent of 8.2 tons per hectare.

## Conclusions

Based on the results of the activities, it was concluded that: (1) Members of the "Sumber Hidup" farmer group are very responsive to community service activities. Farmers heard and asked several questions related to the application of PGPR, planting superior varieties and quality peanut seeds on narrow land; (2) There is a technological transformation process for the use of superior varieties and PGPR in the "Sumber Hidup" farmer group in Sigerongan village; (3) The "Sumber Hidup" farmer group took part in a plot demonstration to compare the use of PGPR and the planting of superior varieties and quality peanut seeds on small plots of land. The results of the demonstration plot show that the application of PGPR on the G19-U1 peanut line produces dry pods: 3,280 g/plot or 8,2 tonnes/Ha.

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