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THE GROWTH, PRODUCTIVITY AND QUALITY OF PEANUTS IMPROVED BY FOUR DIFFRENT RATES OF POULTRY MANURE AND RHIZOBIA INOCULANT

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ABSTRACT

Influences of bat manure (BM) application association rhizobia inoculant on the growth, productivity and quality of peanuts in the infertility grey soil at Triton town, Angiang provice, Vietnam. Four field treatments were designed on the infertile grey soil of Triton district, Angiang during March to July of 2022. Research results presented that bat manure application raised from 0 to 8 tons per ha combinated with rhizobium inoculan remarkably raised number (No.) of pods, Weight (Wt.) of pods per plant, Wt. of seeds/ ha (ton) and Wt. of seeds/ ha (ton). The percentage of oil, protein and NPK of peanut seeds in BM amendment treatments was higher than those of control treatment. Characteristics of its yield components and productivity of peanut were remarkably influenced by the relationship between different BM levels associated with Rhizobia inoculant. Additon treatment of 8.0 tons CM per ha with rhizobia inoculant obtained the highest value in research characteristics compared to other treatments.

Key words: bat manure**,** peanut, productivity, Rhizobia, Triton town.

A. INTRODUCTION

Peanut (Arachis hypogaea L.) is one of popular plants because of its high nutrients. Peanut seed values from 45% to 55% oil, 20% to 25% protein, 16% to 18% 5% carbohydrate and 5% minerals. Besides peanut seeds not only contain high nutritions but also bring high profit. (Gulluoglu, 2011; Gulluoglu et al., 2016).Groundnuts are an important role for improving soil nutritions and crop yield in infertility grey soils (Hafeez et al., 2001). Groundnuts have remarkably played a key role in natural ecosystems, agriculture, and agro-forestry because of their great ability for fixing nitrogen in symbiosis. It could increase the nitrogen level of agricultural soils in low nitrogen environments (Graham and Vanace, 2003). Biological nitrogen fixation (BNF) rate of peanuts, which is a vitalization proclivity for sustainable agriculture production has a quality source of nitrogen to contribute for plants under favorable atmospheric and environmental conditions (Hungria & Vargas, 2000; Chen et al., 2002). The effect of groundnuts has significantly affected by different factors such as soil moisture, available N and the presence of efficient and competitive rhizobium strains (Thies et al., 1995; Young, 2000). According to the potentiality for N fixation and attendance of local rhizobia in soils and/or the growth and amendment of rhizobial inoculation is very important (Giller and Cadisch, 1995It ca). Rhizobium inoculant is the best way for the increase of rhizobia population to promote plant yields and soil nutrients (Keyser and Li, 1992). The positive increase of

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rhizobium population and peanut nodules peanut nodules are strongly created by N_2-fixation even under adverse soil conditions (Peoples et al., 1995). Rhizobium, which is a Gram-ve and free living organism present in soil is the ability to fix the atmospheric nitrogen in symbiotic state only. Rhizobia has also existed such as an end symbiotic N fixing microbiology combined with root of groundnuts (Tarekegn & Kibret, 2017). It enters into crops through the root system then it creates nodule. The fixation of N in root nodules reacts to the available H molecules present and thereby forms NH_3 for which the energy required is obtained from host (Badawi et al., 2011). The carbohydrate produce by legume plants are transported to nodules are utilized by Rhizobium as sole source of hydrogen in the conversion of N to ammonia. The root nodules act as a micro fermentor for biological N fixation where they can convert atmospheric N into ammonia. Rhizobium is able to induce the shoot and root growth in rice plants (Yanni et al., 1999). Rhizobia interaction with the legume host is quite specific and it will fix N in particular host plan only. Rhizobium showes host specificity and it was mediated by plant compounds such as flavonoids which are produced by the host plants (Giller & Cadisch, 1995). Flavonoid activates the nod genes present in Rhizobium. It starts infection in root surface, after which root begins curling. After infection, Rhizobium starts to move into the root hair after certain level bacteria stops its multiplication and form bacteroids which fix N nod and nif genes code for protein called nodulin (Hafeez et al., 2001). It includes leg hemoglobin which is used for nodule development. Genes which are responsible for N fixation. It is present in both free living and symbiotic N fixing bacteria it includes structural genes for nitrogenase and other regulatory enzymes (Choudhurry et al., 2004). There are several methods are available to introduce rhizobium inoculants in soil, seed dipping method is one of the common method for the application of Rhizobia. During seed germination the bacteria infects into root hair and spread towards the root. When the plant grows, Rhizobium will convert N into ammonia for plant growth. Though inorganic (or synthetic) fertilisers are most commonly applied, organic forms such as livestock manure, compost and bat guano are also extensively used throughout the country (Thi et al., 2014). Although bat is commonly traded and used as fertiliser in Cambodia, empirical studies Shrub or small tree. Bat manure provide a good source of NPK and minerals such as calcium and iron (Radovich, 2011; Orwa et al., 2009).

Influences of soil properties is an important role in the soil fertility increase and plant yield. Effects of e organic manures could affect either direct or indirect. Crop practices that relate high application of inorganic fertilizers cause depletion of nutrients and others in soils. It could accumulate in resulting of nutrient imbalance and affect soil yield. Among available means to achieve sustainability in agricultural production, organic matter play an important and key role because they possesses many desirable soil properties and exerts beneficial biological characteristics (Son et al., 2004). The objective of this research found out influences of different BM levels and Rhizobial inoculant on yield, yield components and quality of peanuts planted in grey soil in Triton district, Angiang province, Vietnam.

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B. MATERIALS AND METHODS

1. Microorganisms and Inoculation

Rhizobia were completely collected from The Microbiology Research Institute, the Angiang University. The bag was mixed well with sugar solution and added to seeds of peanut which spreading on a clean plastic sheet under shading. Seeds of peanut were soaked in liquid inocula after diluted 1:1 with well water for 30 minutes before sowing.

2. Experimental design

The experiment was carried out on the local field from March to July of 2022 in Triton town, Angiang province, Vietnam. The experiment consisted of BM1-control (NPK: K at 40, 60 and 50 kg/ ha, respectively), BM 2 (NPK +4 tons BM/ ha + rhizobium), BM3 (NPK + 6 tons BM/ ha + rhizobium), BM 4 (NPK + 8 tons BM/ ha + rhizobium), 4 repeats. Soil samples, which were collected from 0 cm to 20 cm and 20cm to 40cm in depth determined physical-chemical characters. Results of soil characters are presented in (Table 1). Irrigation water for crops was the underground water. The total area of experiment being equivalent to 160 m^2 (0.5 m in width x 20 m in length x 04 repeats x 04 treatments), each single hole was planted in two seeds. The distance of two plants was and 20 cm and 50 cm for two rows. Each of the pots was fertilized with a basal dose of N, P and K at 40, 60 and 50 kg ha^{-1}, respectively. Peanuts (LD14) were sown during the crop. Plants were kept one plant per hot. After the aboveground biomass of peanut was harvested after 10 weeks sowing.

Table 1: Soil characteristics at the first of the experiment

Soil analysis	Soil depth (cm)		Soil analysis	Soil depth (cm)	
	0 -20	20-40		0-20	20-40
Sand (%)	64.0	3.10	Total N (%)	0.124	0.110
Clay (%)	6.20	65.0	Available P (mg/kg)	56.1	54.3
Silt (%)	29.8	31.9	Exchangeble K (mg/kg)	644	612
C (%)	1.77	1.31	Total Ca (%)	25.4	22.5
OM (%)	3.06	2.26	pH	5.55	5.10
C/N	14.2	11.9	EC (µS/cm)	233	203

3. Data collection

Ten samples were collected at 4, 6 and 8 weeks after sowing from each replication. Number, fresh and dry weight of Nodules and fresh weight of branches and biomss per plant were also counted at havest. Samples of ten plants were taken from each treatment to determine number of pods, weight of pods, and weight of seeds per plant (g). Groundnut yields were harvested separately and dried in order to estimate weight of pods yield (t/ha) and weight of seeds. Seed samples were grinded into fine powder and stored in brown glass bottles for chemical analysis.

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4. Analytic Methods

Soil were analyzed according to Piper (1950) and Page et al., (1982). Oil %, and NPK in seeds were determined according to AOAC methods. And the seed protein content was calculated by multiplying total nitrogen concentration by 6.25.

5. Statistology

Study data were statistically analyzed and compared by least significant differences (LSD) at 5% level of probability test according to procedures outlined by statgraphics centurion xv.

C. RESULTS AND DISCUSSION

Table 2: Effects of CM, NPK fertilizer and Rhizobia on the peanut plant heights and No. of branches

Treatment	Plant height (cm)				No. of effective branches/ plant			
	Days after sowing (DAS)							
	20	45	65	Harvest	20	45	65	Harvest
BM1	10.1^{c}	24.0^{d}	48.4^{d}	97.7^{c}	4.00^{c}	10.2^{d}	25.0^{d}	28.0^{d}
BM2	12.1^{b}	26.2^{c}	50.2^{c}	113^{b}	4.40^{bc}	12.0^{c}	26.5^{c}	30.3^{c}
BM3	12.5^{b}	28.7^{b}	52.3^{b}	113^{b}	4.80^{b}	14.5^{b}	27.5^{b}	32.0^{b}
BM4	13.0^{a}	30.2^{a}	55.0^{a}	117^{a}	5.45^{a}	16.8^{a}	28.5^{a}	34.3^{a}
F_{test}	**	**	**	**	**	**	**	**
CV (%)	9.70	9.13	5.00	6.97	14.3	19.0	5.28	8.11

**: significantly difference at $P_{value} \leq 0.01\%$

Effects of CM, Rhizobia and NPK fertilizer on the plant height of peanuts (Table 2) showed that there were sufficiently different at 1% (P<0.01) among treatments. The highest plant height (117 cm) and lowest value (97.7 cm) at harvest, which were observed at treatment BM 4 (NPK + 8 tons CM per ha and Rhizobium inoculation) and BM1 (NPK application alone. Furthermore, Number of effective branches from 20 DAS to harvest at BM4 were higher number of effective branches compared to others. Effective branches, which were sufficient difference at 1% (P<0.01) at all growth stages and had sufficient raised during growth stages (Table 2). The benefit effects of BM and Rhizobia promoted yield components to plant heights and effective branches of peanuts (Aipa & Michael, 2018).

The fresh biomass of peanuts was influenced by co-application of CM, NPK and rhizobium inoculation (Table 3). The peanut biomass increased from 256 g to 570 g /plant. Treatment BM1, which had the minimum biomass (256 g/plant) applied by NPK alone and significant variousness among all treatments (Table 4). Conversely, other treatments had the higher biomass from 428g to 570 g/plant and significant differences at 1%. The results of Table 3 could cause the positive relationship of CM and Rhizobium inoculum with the soil nutrient addition (Awadalla & Mohammed, 2017). The fresh biomass of peanuts may promote strongly when adding organic manures association with Rhizobium inoculum (Doloum et al., 2017).

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Table 3: Effects of BM, rhizobium inoculation yield components of peanut

Treatments	No. of Nodules (plant)	Wt. of Nodules (g/plant)		Fresh Wt. of branches (g/plant)	Fresh Biomass (g/plant)
		fresh	dry		
BM1-control(NPK:40 kg N+60 kg P+50 kg K/ha)	27.0^{d}	1.06^{d}	0.231^{d}	210^{d}	256^{d}
BM2 (NPK +4 tons BM/ ha + rhizobium)	62.0^{c}	6.05^{c}	0.450^{c}	330^{c}	428^{c}
BM3 (NPK +4 tons BM/ ha + rhizobium)	90.0^{b}	8.78^{b}	0.641^{b}	440^{b}	470^{b}
BM4(NPK +4 tons BM/ ha + rhizobium)	159^{a}	13.9^{a}	0.822^{a}	685^{a}	570^{a}
F	**	**	**	**	**
CV (%)	24.0	21.5	21.0	21.9	20.2

**: significantly difference at $P_{value} \leq 0.01\%$

Results of Table 3 proved that number of nudoles were weakly created (27 nodules/ plant) and had 0.231 (g/plant) dry weight of nodoles in no application of BM and rhizobium inoculation (BM1). This suggests that additional and native rhizobia have still presented and raised their population in the soil. Futhermore, the lack of BM addition and rhizobium inoculation was significantly different among them where amended BN level (8 tons/ ha) combination with rhizobium inoculation had 159 nodules of 0.822 dry weight (g/ plant). In treatment BM1, number (27.0) and dry weight of nodules (0.231) had the minimum average values and lower than those of other treatments. The treatment BM4, number and dry weight of nodules were higher than those of control treatments (about 5.5 times). The study result also proved there were remarkably different from all additional treatments of CM combined with rhizobium inoculation, which significant increased fresh weights of nodules (6.05, 8.78 and 13.9 g/plant) and branches (210, 330, 440 and 685 g/ plant) in BM2, BM3 and BM4, respectively. The interactive relationships between BM and rhizobium at different levels of BM significant raised for fresh and dry weight of nodules as well as fresh weight Of branches and fresh peanut biomass (Table Applying a lot of nitrogen fertilizer to peanut soils could decrease the nitrogen fixation of rhizobia. For this reason, number of peanut nodules can be produced less than where N fertilizer is not applied. Fertilization of CM alone or combination with rhizobian inoculant raised higher weight of 1,000 seeds of peanuts than other treatments (Uko et al., 2018; Ghazanfar et al., 2018).

1. Peanut yield and yield component

Results in Table 4 showed that there were significant effect by BM associate rhizobium inoculation on peanut yields and yield components. All peanut characteristics were remarkably reached by increasing different rates of BM from 0 to 8 tons per ha. The significant differences between BM rates had significantly differed by all peanut characters at harvest. Bat manure rate of 8 tons per ha obtained the highest results of number of pods/ plant (42.8 g), weight of pods/ plant(80.2 g), weight of 100 and 1.000 seeds (57.5 and 558 g) and yield of pods (7.59 tons/ha). Bat manure is a key role in promoting better growth and yield of vegetative and

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reproducing peanut organs and increases of photosynthesis rate and photosynthetic matter production and sequently the yield components and seeds. Treatment BM4 obtained the maximum yield per ha (7.59 tons/ ha) and significant differences from others, while the minimum yield (4.63 tons/ ha) was observed from the control treatment (BM1). Yield per ha varied from 4.63-7.59 tons per ha depending on the BM different rates. The peanut yield of treatment BM4 increased 39.0% compared to treatment BM1 (control). In generally, the yield percentage of BM2, BM3 and BM4 increased from 6.8%, 25.2% to 39%, respectively, comparison with the control treatment (Table 4).

Table 4: Effect of BM combination with rhizobium inoculation on yield components and yields of peanut

Treatment	No. of pods /plant	Wt. of pods (g/plant)	Wt. of seeds (g)		Yield (ton/ha)
			100	1,000	
BM1	30.1^{d}	56.1^{d}	40.0^{d}	435^{d}	4.63^{d}
BM2	36.1^{c}	64.9c	49.0^{c}	485^{c}	5.25^{c}
BM3	40.3^{b}	74.4^{b}	52.0^{b}	513^{b}	6.19^{b}
BM4	42.8^{a}	80.2^{a}	57.5^{a}	558^{a}	7.59^{a}
F	*	*	*	*	**
CV (%)	14.9	12.1	10.4	10.7	12.5

**: significantly difference at $P_{value} \leq 0.01\%$

2. Peanut quality traits

The oil, protein and NPK concentration of peanut seeds were significantly affected by BM rates. The lowest contents of oil (44.0%), seed protein (20.0%) and NPK content in seeds (3.20, 0.820 and 0.709%, respectively) were observed by control treatment, which received without BM and Rhizobium inoculation (Table 5). Higher levels of BM combined with Rhizobium inoculation raised peanut seed quality by promoted to protein, oil and NPK contents. These results are in harmony with those obtained by Abdel-Wahab et al., (1988);. Percentage of N, P and K were significant differences during the growing crop. Bat manure and Rhizobium inoculation (BM4) had the greatest values of oil (46.9%), seed protein (26.9%) and NPK (4.46, 0.94 and 0.99%, respectively). These results are in harmony with those obtained by Bogino et al., (2006) and Nasr-Alla et al., (1998).

Study data in Table 5 indicated significant differences by the interaction among treatments. Treatment BM1 had the minimum percentage of oil, protein and NPK in seeds. While 8 tons BM/ ha with Rhizobium inoculation treatment obtained the highest qulity of protein, oil and NPK content in seeds. This means that bat manure and inoculation with rhizobia not only raised peanut yield and yield components but also improved seed nutritive values. These results may be brought from the positive effect of nitrogen on metabolic processes and growth which in turn reflected positively on the chemical content of peanut seeds. These results are in harmony with those obtained by Purushotham and Hosmani, (1994). All growth parameters were improved when peanut plants received the dual inoculation some rhizoorganisms under sandy

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loam soil (Badawi et al., 2011). Moreover, inoculation with phosphate solubilizing rhizobacteria enhancement N_2 fixation (Gyaneswar et al., 1999)]. A great potential of peanut growth was resulted by rhizobium inoculation with bullshit application. Continued application of organic fertilization and rhizobium inoculation enhanced nodule formation and reduced the need to chemical fertilizer and pesticide ultimate, conserved environment and braving sustainability (Vicario et al., 2016; Sundara, 1971).

Table 5: Effect of BM and Rhizobium inoculation on the quality of peanut seeds

Treatment	Characters				
	Seed protein (%)	Seed Oil (%)	NPK content in seed (%)		
			N	P	K
BM1	20.0[d]	44.0[c]	3.20[d]	0.800[d]	0.709[d]
BM2	23.4[c]	45.5[b]	3.74[c]	0.829[c]	0.800[c]
BM3	24.0[b]	45.5[b]	3.84[b]	0.849[b]	0.922[b]
BM4	26.9[a]	46.9[a]	4.46[a]	0.940[a]	0.990[a]
F	**	**	**	**	**
CV (%)	12.6	11.3	12.6	11,3	13.5

**: significantly difference at $P_{value} \leq 0.01\%$

D. CONCLUSIONS

The rhizobium inoculation combined with CM manures fertilization have popularly used such as an available tool for the agriculture cultivation in promoting the growth, yield and soil fertility. The usage of high inorganic fertilizers could be decreased by exploiting N fixing biology strains, which will be replaced to reduce the use of chemical fertilizers in turn affects the plant growth, soil health and it has caused severely harmful effects to humans. Overcoming these problems, the study of BM and Rhizobium inoculation needs to use in order to create a pollution free agricultural ecosystem. Application of modern molecular techniques are highly useful to create more potential nitrogen fixing strains with higher potential.

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