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GROWTH ANALYSIS OF SITU BAGENDIT VARIETY IN RAINFED LOWLAND RICE WITH NITROGEN AND PHOSPHORUS FERTILIZERS APPLICATION

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ABSTRACT

Water is one of the factors limiting rice cultivation on raindrop land. The provision of micorizha can help the absorption of water in the soil solum deeper. Besides, it can also save the use of nitrogen and phosphor fertilizers in water-choked conditions.This research aims to know the optimizing dosage of nitrogen and phosphorus fertilizers on growth in rainfed lowland rice applied by mycorrhizae. The research method was a randomized complete block design (RCBD) with three replications. The first factor was the dosage of nitrogen fertilizer, which consisted of four levels, i.e., 0, 45, 90, and 135 kg ha^{-1}. The second factor was the dosage of phosphorus fertilizer, which consisted of four levels, i.e., 0, 25, 50, and 75 kg ha^{-1}. The results showed that fertilizer dosage of nitrogen of 90 kg ha^{-1} and phosphorus of 50 kg ha^{-1} increased the leaf area index (LAI), leaf area duration (LAD), net assimilation rate (NAR), and crop growth rate (CGR). The application of nitrogen and phosphorus fertilizer can improve the Situ Bagendit variety's physiological character better than without fertilizer. Rice cultivation in rainfed lowland rice given mycorrhizae should use nitrogen of 90 kg ha^{-1} and phosphorus of 50 kg ha^{-1}.

Keywords: mycorrhizae, rainfed lowland rice, drought stress

INTRODUCTION

Plant growth is an event where an increase in cell number or an increase in plant dry weight.Ayuningtyas et al. (2016) define growth is as a process of cell division or an increase in the number of irreversible cells, while Moraes et al. (2014) are increasing biomass.

Internal and external factors influence the process of plant growth. Leaves are an internal factor that acts as a photosynthetic organ. The shape and size of leaves are crucial in catching the sunlight as the main energy source. External factors that affect plant growth include nitrogen and phosphorus fertilizer.The application of balanced fertilizers can stimulate vegetative growth. The need for nitrogen and phosphorus nutrients must be met to support plant growth. The optimal vegetative growth phase will provide maximum generative results.

Nitrogen and phosphorus are nutrients needed by plants in large quantities in the formation of chlorophyll, protoplasm, protein, and nucleic acids. This element has an essential role in the growth and development of all living tissues (Suharja & Sutarno 2009). Phosphorus is a necessary component of energy transfer compounds, genetic information systems, cell membranes, and phosphoproteins (N Ayuningtyas, Susilowati, and Arifin 2016). Breuninger et al. (2004) reported that mycorrhizae could absorb glycine and glutamic acid and transport nitrogen from these sources to the host plants. Mycorrhizae are involved in increasing nitrogen uptake and assimilation by host plants (Cavagnaro & Barrios-Masias 2012; Thakur & Shinde 2020).

Dry weight is the result of overall growth, but its achievement occurs through dynamic growth over time. The hoarding of photosynthetic net or dry weight in an integrated manner with time is referred to as growth analysis (N Ayuningtyas et al. 2016). Two measurements are needed in a time interval to analyze the plant growth, namely the leaf area and the total dry weight.

With sufficient nitrogen and phosphorus, the photosynthesis process will run smoothly to spur plant growth. Crop growth rate (CGR) is a function of leaf area index (LAI), leaf area duration, and net assimilation rate (NAR). With optimum nitrogen and phosphorus, leaf area index, leaf area duration, and net assimilation rate reach the optimum, the crop growth rate is also optimum (Bianchi et al. 2020). Qi et al. (2020), in their research using nitrogen fertilizers at doses of 200 kg. Ha^{-1} increased LAI, NAR, CGR, chlorophyll value, and yield.

The use of phosphorus fertilizer combined with biochar (Zhu et al. 2019) can increase the net photosynthetic rate, chlorophyll index, leaf area duration, and 23% yield on soybean plants, which are inefficient P. in his research using 1% biochar and P fertilizer 150 kg ha^{-1}.

In rainfed lowland rice, water stress occurs. One method of overcoming water shortages is microbial-based technology, such as vesicular-arbuscular mycorrhizae (VAM). Mycorrhizae can increase the absorption of the most important nutrient factors P and other nutrient factors such as N, K, Ca, Mg, Cu, Mn, and Zn; production of hormones and growth regulators, as well as drought resistance (Watanarojanaporn et al. 2013). VAM mushrooms also play a role in improving plant nutrient status, increasing development and growth and distributing plant resistance to drought (Bhattacharjee & Sharma 2011).

The Situ Bagendit variety is a rice variety suitable for paddy fields, and dry land has tillers number of 12-13 stems $clump^{-1}$, the long and slender grain is pure white, has a fluffier rice texture, and is in great demand by consumers. Potential yield of 4.0 tons ha^{-1} of milled dry unhulled rice in dryland and 5.5 tons ha^{-1} in paddy fields (Anonimous 2011).

According to Laghari et al. (2016), nitrogen at a level of 120 kg ha^{-1} showed promising results for rice plant height, number of tillers, dry weight, panicle length, number of filled grain $panicle^{-1}$, straw yield, biological yield, harvest index, and grain yielded 4.66 tons ha^{-1}. Meanwhile, regarding the dose of P, in Cambodia, in rainfed rice fields, a dosage of 8-10 kg of phosphorus can produce 2.5-3.0 tons of grain ha^{-1} (Seng et al. 2001). Research by Pheav et al. (2005) concluded that the use of phosphorus of 8–10 kg ha^{-1} could produce 2.5-3.0 tons ha^{-1}. Kokou et al. (2012) added that N, P_2O_5, and K_2O fertilizers, respectively, 139.86, 7.2, and 120 kg ha^{-1} were the optimum dosage for IR64 varieties.

This study aimed to know the optimizing dosage of nitrogen and phosphorus fertilizers to rice growth in rainfed lowland, which was applied by mycorrhizae.

MATERIALS AND METHODS

Study site

This research was tested in April to July 2019 on regosol rainfed lowland rice in Demangan, Sambi, Boyolali, Central Java, Indonesia. A geographical position was between 110° 22'-110° 50' east longitude and between 7°7' - 7°36' south latitude with a height of 184 m above sea level (ASL), and the average rainfall is 139 mm month^{-1}.

Experiment design

The research method was RCBD with three replications. The first factor was a dosage of nitrogen fertilizer, which consisted of four levels, i.e., 0, 45, 90, 135 kg ha^{-1}. The second factor was a dosage of phosphorus fertilizer, which consisted of four levels, i.e., 0, 25, 50, and 75 kg ha^{-1}.

Research procedures

Soil tillage is done by plowing, then given manure at a dose of 10 tons ha^{-1}. The plots were made in a size of 4.0 m x 1.2 m. The need for manure plot^{-1} was 1.92 kg, so that in this study, 16 g of manure was needed plant^{-1}.

Seeding is done by spreading it on the prepared planting media. Seedlings are ready to be planted at the age of 20 days after sowing. Rice seedlings are planted at a spacing of 20 cm x 20 cm so that the need for seedlings is 120 seeds plot^{-1}. The overall need for seeds is 1,920 seeds.

Urea and SP36 fertilizer were given according to the treatment, namely the first stage at 14 days and the second at 30 days after planting (DAP). KCl fertilizer at a dosage of 75 kg ha^{-1} was given simultaneously at the age of 30 DAP in all plots.

Irrigation cannot be done and only rely on rainwater. Plant maintenance is carried out, including embroidery at the age of 7 DAP and weed control at 14 DAP.

Parameters

The parameters observed were LAI, LAD, NAR, and CGR were recorded at 0 up to 12 weeks after planting and was calculated using the following formula:

The leaf area index (LAI) is the ratio of the total leaf area of one rice clump^{-1} against the plant spacing or ground area shaded by the plant canopy. The LAI value was calculated using the formula in Equation 1.

$$\text{LAI} = \frac{\text{LA}}{\text{P}} \text{ ....(1)}$$

Where: LA = total of leaf area, and P = plant spacing or ground area that shaded

LAD is leaf area at a certain period. The LAD value was calculated using the formula in Equation 2.

$$\text{LAD} = \frac{\text{LAI}_1 + \text{LAI}_2}{2} \times (\text{T}_2 - \text{T}_1) \text{ (cm}^2 \text{ week}^{-1}) \text{ ....(2)}$$

Where: LAI_1 = LAI of plant clump^{-1} recorded at time T_1, LAI_2 = LAI of plant clump^{-1} recorded at the time T_1, T_1 and T_2 were the interval of time, respectively.

NAR is plants' ability to produce dry matter due to assimilation per leaf area per unit time. The NAR value was calculated using the formula in Equation 3.

$$\text{NAR} = \frac{\text{W}_2 - \text{W}_1}{\text{T}_2 - \text{T}_1} \times \frac{\ln \text{LA}_2 - \ln \text{LA}_1}{\text{LA}_2 - \text{LA}_1} (\text{g cm}^{-2}\text{week}^{-1}) \text{ ....(3)}$$

Where: W_1 = dry weight of plant clump^{-1} recorded at the time T_1, W_2 = dry weight of plant clump^{-1} recorded at the time T_1, LA_1 = leaf area of plant clump^{-1} recorded at the time T_1, LAI_2 = leaf area of plant clump^{-1} recorded at the time T_1, ln = logarithm natural

CGR is the ability of plants to produce dry matter due to assimilation per unit area of land per unit of a certain time short. The CGR value was calculated using the formula in Equation 4.

$$\text{CGR} = \frac{1}{\text{A}} \times \frac{\text{W}_2 - \text{W}_1}{\text{T}_2 - \text{T}_1} (\text{mg cm}^{-2}\text{day}^{-1}) \text{ ....(4)}$$

Where: A =fields area or plant spacing, W_1 = plant dry weight recorded at time T_1, W_2 = plant dry weight recorded at time T_2, otherwise T_1 and T_2 were the respective time intervals.

Statistical analysis

The data of observations were analyzed using analysis of variance (ANOVA) at 5% significant levels. The treatment means were compared using Duncan's new multiple range test (DMRT) at 5% significant levels.

RESULTS AND DISCUSSION

Leaf Area Index

Based on the analysis of variance on LAI, the treatment of nitrogen and phosphorus dosage at 0-3, 3-6, 6-9, and 9-12 WAP have significant effects, except for the treatment of phosphorus 0-3

WAP. There is no interaction between the two treatments. The average of LAI was presented in Table 1.

Table 1. Average of LAI at 0-3, 3-6, 6-9, and 9-12 WAP

Treatment	**Observation (WAP)**			
	0-3	**3-6**	**6-9**	**9-12**
Nitrogen (kgha^{-1})				
0	0.960 a	1.773 a	2.250 a	2.281 a
45	1.101 ab	2.654 ab	3.246 ab	3.437 b
90	1.637 ab	3.498 b	3.139 ab	3.815 b
135	1.676 b	3.607 b	3.842 b	4.830 c
Phosphorus (kg ha^{-1})				
0	1.213 a	2.273 a	2.523 a	2.733 a
25	1.284 a	2.591 ab	3.258 a	3.776 b
50	1.438 a	3.094 ab	3.126 a	3.832 b
75	1.437 a	3.575 b	3.570 a	4.022 b
Interaction	(-)	(-)	(-)	(-)

Note: The column's average number was followed by the same characters no significantly different based on DMRT at 5% significant levels. (-) = no significant interaction

Table 1 shows that LAI growth increases from observations 0-3 to 9-12 WAP on all treatments. LAI on observations 0-3, 3-6, 6-9, and 9-12 WAP, the dosage of 135 kg reaches the highest number and is significantly different from without nitrogen fertilization, but the dose is 45, 90 nor did 135kg ha^{-1} show any difference, except for observations 9-12 WAP. In 9-12 WAP observations, LAI at a dose of 135 kg ha^{-1} was different from 45 and 90 kg ha^{-1}, a dose of 45 and 90 kg ha^{-1} was also different from without nitrogen fertilizer.

At 0-3 and 6-9 WAP observations in the phosphorus dose treatment, LAI was no difference at a dose of 0, 45, 90, 145 kg ha^{-1}. It means that at age, there is no need for phosphorus. It is suspected that mycorrhizae's role is very dominant at that age. One of the mycorrhizal functions is increasing phosphorus uptake, increasing phosphorus absorption, and LAI will also increase.At 3-6 WAP, phosphorus doses of 25 and 50 kg ha^{-1} were not significantly different from those without phosphorus. LAI at a dosage of 25 and 50 kg ha^{-1} was also not different from the dosage of 75 kg ha^{-1}, but LAI at a phosphorus dose of 75 kg ha^{-1} was significantly different from that without phosphorus.

Leaf área index (LAI) is the ratio between leaf surface area and land surface área over grown with plants (Ayuningtyas et al. 2016; Rajesh et al. 2011). LAI is closely related to the plant's ability to keep the light from solar radiation that is coming. LAI values needed to hold 95% of the light come in the rice canopy around 4-8 for photosynthesis (Rajesh et al. 2011). LAI is a photosynthetic area of the plant (Rajput et al. 2017; Zulkarnaini et al. 2019).

In the nitrogen dosage treatment, nitrogen at all observation stages increased the leaf área index of Situbagendit rice variety planted in lowland rice applied by mycorrhizae. It is because one of the functions of nitrogen is as a constituent of chlorophyll. Chlorophyll is the center of photosynthesis. The stronger the photosynthesis process will increase plant growth, including leaf size (Ayuningtyas et al. 2016). Thapa et al.(2019) reported that nitrogen fertilizer influences LAI by increasing the tiller number and leaves size. Ko et al. (2017) found that young seedlings, closer spacing, and urea application recorded more tillers per unit area resulting in increased LAI. LAI was highly significantly affected by fertilizer type at all growth stages.

Likewise, what happens in the treatment of phosphorus dosage. ATP is a chemical compound as energy for dark photosynthesis reaction, which will form carbohydrates that accumulate in the leaves (N Ayuningtyas et al. 2016). The role of mycorrhizae, in this case, is less influential compared to the dosage of fertilizer applied. These are caused by the lack of mycorrhizae, which is not enough, or the application method is not right.

Leaf Area Duration

Based on the ANOVA on LAD, nitrogen and phosphorus dosage treatment at 0-3, 3-6, 6-9, and 9-12 WAP have significant effects, except phosphorus treatment at 0-3 WAP. There is no interaction between the two treatments. The average of LAD was presented in Table 2.

Table 2 Average of LAD ($cm^2 week^{-1}$) at 0-3, 3-6, 6-9, and 9-12 WAP

Treatment	**Observation (WAP)**			
	0-3	**3-6**	**6-9**	**9-12**
Nitrogen (kg ha^{-1})				
0	575 a	1,639 a	2,464 a	2,768 a
45	660 ab	2,253 ab	3,540 ab	4,009 ab
90	982 ab	3,081 bc	3,982 b	4,088 ab
135	1,005 b	3,169 c	4,369 b	5,020 b
Phosphorus (kg ha^{-1})				
0	727 a	2,091 a	2,877 a	2,987 a

25	770 a	2,325 ab	3,509 ab	4,220 ab
50	863 a	2,719 ab	3,732 ab	4,175 ab
75	862 a	3,007 b	4,236 b	4,505 b
Interaction	(-)	(-)	(-)	(-)

Note: The column's average number was followed by the same characters no significantly different based on DMRT at 5% significant levels. (-) = no significant interaction

Based on Table 2, LAD growth increased from observations 0-3 to 9-12 WAP on all treatments.The nitrogen dosage of 135 kg ha^{-1} in observations 0-3, 3-6, 6-9, and 9-12 WAP shows the highest numbers. At 0-3 WAP, the dosage of 135 kg ha^{-1} did not differ from the dosages of 45 and 90 kg ha^{-1}. However, 45 and 90 kg ha^{-1} did not differ from without nitrogen. It means that there is no increase in LAD at 0-3 WAP with the nitrogen of 45 and 90 kg ha^{-1}. It is suspected that at the age of 0-3 WAP, soybean plants need less N fertilizer because of mycorrhizae role, which helps nutrient uptake. Besides, the plants still use the food reserves found in seeds.

At 3-6 and 6-9 WAP, LAD at a 45 kg ha^{-1} was no different from without nitrogen fertilizer, whereas at 9-12 WAP the dosage was 45, and 90 kg ha^{-1}nitrogen is no different without nitrogen fertilization. Seeing a pattern like this shows that nitrogen on land given mycorrhizae needs a high dosage so that the LAD is different compared to without nitrogen. It is presumably because the hyphae of mycorrhizal fungi are already long to absorb more water and nutrients. LAD shows the same pattern as LAI, namely the increasing nitrogen dosage, the LAD also increases.

Likewise, the increased phosphorus is given, the LAD will increase except 0-3 WAP because there is a role for nitrogen and phosphorus fertilizer. It is similar in his research (Kabir et al. 2013) that phosphate fertilizer with a dosage of 50 kg ha^{-1} is better than 25 kg ha^{-1} on plant height, branches number $plants^{-1}$, crop growth rate, and leaf area index of groundnut.

Net Assimilation Rate

Based on the ANOVA, nitrogen dosage treatment significantly affected 9-12 WAP and phosphorus dosage treatment significantly impacted 0-3 WAP. There was no interaction between the two treatments. The DMRT result at 5% level was presented in Table 3.

Table 3. Average of NAR (g $cm^{-2}week^{-1}$) at 0-3, 3-6, 6-9, and 9-12 WAP

Treatment	**Observation (WAP)**			
	0-3	**3-6**	**6-9**	**9-12**
Nitrogen (kg ha^{-1})				

0	126.26 a	21.56a	15.55 a	3.83 a
45	122.57 a	31.47 a	22.60 a	9.65 ab
90	133.33 a	24.17 a	23.76 a	20.70 b
135	158.25 a	27.78 a	12.44 a	12.34 ab
Phosphorus (kg ha^{-1})				
0	115.24 ab	25.79 a	22.74 a	10.71 a
25	102.22 a	29.15 a	17.46 a	11.33 a
50	144.38 ab	25.57 a	18.53 a	11.82 a
75	178.57 b	24.47a	15.62 a	12.66 a
Interaction	(-)	(-)	(-)	(-)

Note: The column's average number was followed by the same characters no significantly different based on DMRT at 5% significant levels. (-) = no significant interaction

In Table 3, the highest NAR growth occurred in 0-3 WA and decreased in observations of 3-6 to 9-12 WAP in all treatments. It can be seen that the nitrogen treatment, NAR at 0-3, 3-6, and 6-9 WAP at dosages of 45, 90, and 135 kg ha^{-1}did not differ from without nitrogen, whereas 9-12 WAP at different nitrogen dosage shad different NAR effects. The highest NAR was at nitrogen dosages of 90 kg ha^{-1} and significantly different from those without nitrogen fertilization, but did not differ from the dosage of 45 or 135 kg ha^{-1}.

In thetreatment of phosphorus dosages (Table 3), NAR at 3-6, 6-9, and 9-12 WAP, at dosages of 45, 90, and 135 kg ha^{-1}did not differ from without phosphorus fertilization (0 kg ha^{-1}). On the 0-3 WAP observation, it looks different. The highest NAR was at a phosphorus dosage of 75 kg ha^{-1} and was different from a dosage of 25 kg ha^{-1}, but did not differ from 50 kg ha^{-1} and without phosphorus fertilization. NAR determines the RGR (Shipley 2006).

The NAR measures the average photosynthetic efficiency of leaves in a community of cultivated plants (N Ayuningtyas et al. 2016). NAR is the production of dry matter per unit leaf area per unit time. This subject explains that leaves and light are the determining aspects in the manufacture of assimilation results. The wider the leaves and the more light that can be absorbed, until the resulting assimilation continues to get bigger. NAR will increase if all leaves are exposed to light and are not protected by other leaves

Crop Growth Rate

CGR increases plant weight per unit area of land occupied by plants at a certain time (Harish et al. 2017). Based on the analysis variance on CGR, nitrogen dosage treatment significantly affected 0-3, 3-6, and 9-12 WAP, and the treatment of phosphorus dosage significantly affected 0-3 and 9-12 WAP. There was no interaction between the two treatments. The average of CGRR at 0-3, 3-6, 6-9, and 9-12 WAP could be seen in Table 4.

Table 4. Average of CGR (mg cm^{-2}day^{-1}) at 0-3, 3-6, 6-9, and 9-12 WAP

Treatment	**Observation (WAP)**			
	0-3	**3-6**	**6-9**	**9-12**
Nitrogen (kg ha^{-1})				
0	22.12 a	21.33 a	73.11 a	7.95 a
45	21.25 a	48.17 ab	60.43 a	27.38 ab
90	37.42 ab	54.26 ab	55.34 a	48.37 ab
135	36.52 b	71.17 b	42.75 a	59.16 b
Phosphorus (kg ha^{-1})				
0	30.52 a	40.17 a	66.37 a	19.16a
25	22.41 a	57.26 a	56.72 a	35.37ab
50	20.12 ab	50.19 a	44.43 a	42.96b
75	44.26 b	47.31 a	64.11 a	45.37b
Interaction	(-)	(-)	(-)	(-)

Note: The column's average number was followed by the same characters no significantly different based on DMRT at 5% significant levels. (-) = no significant interaction

Table 4 showed that CGR growth stable trend from observations 0-3 to 9-12 WAP on all treatments, except in without nitrogen or phosphorus fertilizer. The CGR at 0-3 WAP, the nitrogen dosage of 90 kg ha^{-1} does not differ from 45 kg ha^{-1}. Without nitrogen fertilization and dosages of 90 kg ha^{-1} also does not differ from a dosage of 135 kg ha^{-1}. CGR at a dosage of 135 kg ha^{-1} is different from that without nitrogen fertilization. The highest CGR was found at the dosage of 90 kg ha^{-1} but did not differ from 135 kg ha^{-1}. The CGR at 3-6 WAP and 9-12 WAP at nitrogen dosage treatment have the same pattern. CGR at nitrogen dosages of 45, 90, and 135 kg ha^{-1} did not differ. CGR at the dosage of 45, 90, and 0 kg ha^{-1} was also no different. At 3-6 and 9-12 WAP this CGR was highest at a nitrogen dosage of 135 kg ha^{-1}.

At 0-3 WAP observation, the CGR dosage of 25 kg ha^{-1} was not different from the dosage of 50 kg ha^{-1} or without phosphorus fertilization in the phosphorus dosage treatment. However, the dosage of 50 kg ha^{-1} is also no different from 75 kg ha^{-1}. The highest was at a dosage of phosphorus 75 kg ha^{-1}. In 9-12 WAP observations, CGR at dosages of 25, 50, and 75 kg ha^{-1} did not differ. Likewise, the dosage of 25 kg ha^{-1} did not differ from those without phosphorus fertilization.

The CGR has the same pattern as LAI, meaning that the more LAI increases, the CGR will increase. According to Ko et al. (2017), increased LAI and total dry matter production using younger seedlings have higher CGR. Permanasari et al. (2016) stated that during the initial growth stage. The CGR and NAR values increased due to more numbers of tillers and leaves per unit area.

CONCLUSION

The research results and the discussion above could be taken as follows. The fertilizer dosage of nitrogen of 90 kg ha^{-1} and phosphorus of 50 kg ha^{-1} increased the leaf area index (LAI), leaf area duration (LAD), net assimilation rate (NAR), and crop growth rate (CGR). The application of nitrogen and phosphorus fertilizer can improve the Situ Bagendit variety's physiological character better than without fertilizer. Rice cultivation in rainfed lowland rice given mycorrhizae should use nitrogen of 90 kg ha^{-1} and phosphorus of 50 kg ha^{-1}.

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Pada padi sawah tadah hujan berlangsung cekaman air. Salah satu metode menanggulangi kekurangan air yaitu dengan teknologi berbasis mikroba, semacam vesicular- arbuscular mycorrhizae(VAM). Mikoriza bisa tingkatkan penyerapan faktor hara paling utama P serta faktor hara lain semacam N, K, Ca, Mg, Cu, Mn, serta Zn; pembuatan hormon serta zat pengatur tumbuh, serta ketahanan terhadap kekeringan(Watanarojanaporn et al. 2013). Jamur VAM pula berperan untuk memperbaiki status hara tumbuhan, tingkatkan perkembangan serta pertumbuhan serta membagikan ketahanan tumbuhan terhadap kekeringan(Bhattacharjee& Sharma 2011).

In rainfed lowland rice, water stress occurs. One method of overcoming water shortages is microbial-based technology, such as vesicular-arbuscular mycorrhizae (VAM). Mycorrhizae can increase the absorption of the most important nutrient factors P and other nutrient factors such as N, K, Ca, Mg, Cu, Mn, and Zn; production of hormones and growth regulators, as well as drought resistance (Watanarojanaporn et al. 2013). VAM mushrooms also play a role in improving plant nutrient status, increasing development and growth and distributing plant resistance to drought (Bhattacharjee & amp; Sharma 2011).