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EFFECT OF MYCORRHIZA FUNGI PROPAGULES AND BOKASHI FERTILIZER COMBINATION TO WEED DENSITY, GROWTH AND YIELD OF MAIZE (*ZEA MAYS* L.) ON MARGINAL DRY LAND IN REGENCY OF KENDARI, INDONESIA

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ABSTRACT

This research was conducted in the Field Laboratory of Agriculture Faculty, Halu Oleo University, District Kambu, Regency of Kendari, Province of Southeast Sulawesi, Indonesia. The objectives of the research was determined the impact of mycorrhiza fungi and bokashi fertilizer to weed density, growth and yield of maize. The research was conducted in completely randomized block design (CRBD) with factorial pattern and each treatment was repeated three times. The observed variables were weed density, plant height, leaf area, cob length, cob diameter, number of row seed cob^{-1}, seed number cob^{-1}, dry weigth of 100 seeds, harvest index and shoot root ratio. The results showed that the dominance value of weeds at age 14 DAP as such as 96.14%, at the age of 28 DAP as such as 94.99%, at the age of 42 DAP as such as 98.66%, at the age of 56 DAP as such as 88.52%, and at the age of 70 DAP as such as 85.19%. The combination applied of mycorrhiza fungi and bokashi fertilizer has a significant effect on the plant height age 28 DAP, leaf area age 14 and 28 DAP, cob length and diameter, number of row seed cob^{-1}, dry weigth of 100 seeds and shoot root ratio.

INTRODUCTION

The maize plant is cereal crops important for some communities in Indonesia as food and livestock requirements. The main obstacle in the increased production of maize is the condition of marginal dry land with low of soil fertility, poor in organic matter, nutrient content is very low especially nitrogen (N), phosphorus (P), potassium (K), Magnesium (Mg), low pH, saturation Aluminium (Al) high and a low level of base exchange (Halim *et al.,* 2015). To increase the productivity of marginal soil fertility can be done by applying biotechnology in plant cultivation system are application of mycorrhiza fungi and organic fertilizer (Halim *et al.,* 2015), especially bokashi fertilizer from secondary vegetation (Karimuna and Halim, 2011). The mycorrhizae are symbiotic associations between fungi and higher plants root system, which literally means "fungus root". The relationship between fungi and plant roots provide benefits where the fungi obtain carbohydrates and energy from plants, while the plants get the nutrients needed for growth (Bethlenfalvay and Linderman, 1992).

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According Bolan (1991); Marschner and Dell (1994), that mycorrhiza fungi play an important role in the absorption of nutrients, especially phosphorus by producing phosphatase enzyme which can release bound elements of Phosphorus, Aluminium and Ferrum on land surly and Calcium in calcareous soil so that the Phosphorus will be available to plants. In addition, fungi mycorrhiza can protect plant roots from soil born pathogen (Perrin, 1990; Halim *et al.,* 2016), increasing plant resistance to drought (Auge, 2001), increasing the uptake of water and nutrients from the soil (Halim *et al.,* 2015), increasing the uptake of N, P and Ca (Delvian, 2005) as well as the plant is able to compete with weeds (Halim, 2009). Bokashi fertilizer is a type of organic fertilizer obtained from the fermentation of organic material with the help of effective microorganism-four (EM-four). In the process of weathering of organic matter, EM-four fermenting organic matter in the soil and releasing the results of the fermentation in the form of sugars, vitamins, lactic acid, amino acids and other organic compounds (Indriani, 2000). According to Karimuna and Halim (2011), the bokashi fertilizer can improve soil structure, increase soil absorption of water, improved the living conditions of microorganisms in the soil as well as a nutrient source for plants. The bokashi fertilizer raw materials in this study were taken from the secondary vegetation fallow land.

The compositions of plant species in the secondary vegetation is very varied and greatly affect the rate of growth and development of plant species that compose well as being influenced by soil type, age and climate. In the secondary vegetation of various kinds during the "fallow" containing biomass is not small and it is a source of organic matter and mulch and nutrients for the next crop is planted on conventional farming systems. Results of research Kato (1998); Karimuna (2000), indicates that the secondary vegetation biomass accumulation and nutrient stocks are plentiful and can be used as a source of nutrients in the cropping system. The secondary vegetation aged 2-10 years can accumulate 14-162 t ha^{-1} of biomass and nutrient or equivalent to the 154-872 kg ha^{-1} of N, 13-18 kg ha^{-1} of P and 137- 1027 kg ha^{-1} of K.

The increasing soil fertility in crop acreage of maize, it is inseparable from the existence of various types of weeds that grow in the planting area of maize. The presence of weeds in crop areas affects the crop. This happens because the weed has a high ability to compete with plants for water, nutrients, sunlight, CO2, and a place to grow (Rao, 2000). Crop yield loss due to weeds is highly variable and difficult to estimate because its influence cannot be readily observed (Fadhly and Fahdiana, 2005). The variations loss of crop yield was determined by the critical period of plant (Kevin *et al.,* 2007). Critical period of crop started at the age of 20-45 days after planting (Moenandir, 1993), since the plant grows up to a period of a quarter or a third of the age of the plant (Ferrero *et al.,* 1996; Hartzler and Pringnitz, 2005), and at the age of 2-8 weeks after planting (Utomo *et al.,* 2004). The maize grown in monoculture with a low input cannot provide the optimum yields due to intensified competition with weeds (Clay and Aquilar, 1998). Therefore, a weed that grows on corn crop acreage if left without any control, then the weeds will have the potential to compete with the crop.

Experimental

Study Area and Experimental Setup

Present study was conducted in the field Laboratory of Agriculture Faculty, Halu Oleo University, Southeast Province, Indonesia. This research is compiled using a nested plot design to identified the kinds of weed in the planting area of maize. The research was conducted in completely randomized block design (CRBD) with factorial pattern and each treatment was repeated three times. The first factor are mycorrhiza fungi propagules (A) with three level i.e.: without mycorrhiza fungi propagules (A0), mycorrhiza fungi propagules as 10 g each planting hole (A1), mycorrhiza fungi propagules as 15 g each planting hole (A2) and second factor are bokashi fertilizer (B) which comprises three level i.e.: without bokashi fertilizer (B0), bokashi fertilizer as 15 kg each plot (B1), bokashi fertilizer as 22.5 kg each plot (B2).

Preparation of Planting Area

The vegetation growing on land used as a research first cleaned. Further processing is done using a hand tractor ground twice to be loose. After the loose soil, then made a total of 12 research plots plots with the size of each plot 4 m x 2 m, 30 cm for height swath, 30 cm for distance between treatments, 50 cm for the distance between plotted in the treatment. The channel of dreinase created between the swaths as such as 50 cm of width to facilitate the flow of water, so there is no flooding.

Table 1. The kind of weeds that grow among the research sites before clearing of the land

No.	Kinds of weed	Family
	Broad leaves	
1.	*Ageratum conyzoides* (L.)	Asteraceae
2.	*Ageratum haustonianum* Mill	Asteraceae
3.	*Alternanthera philoxeroides* (Mart) Griseb	Amaranthaceae
4.	*Amaranthus gracilis* Desf	Amaranthaceae
5.	*Bidens pilosa* L.Var Minor	Asteraceae
6.	*Borreria alata* (Aubl.) DC	Rubiaceae
7.	*Acalypha indica* (L.)	Euphorbiaceae
8.	*Centrosema plumieri* (Pers) Beath	Leguminoceae
9.	*Eupatorium odorata* (L.)	Asteraceae
10.	*Ruellia tuberosa* (L.)	Acanthaceae
11.	*Eupatorium peltescens* (L.)	Asteraceae
12.	*Cleome rutidospermai* DC	Capparidaceae
13.	*Cosmos caudatus* Kunth	Asteraceae
14.	*Commelina nudiflora* (L.)	Commelinaceae
15.	*Galingsonga parviflora* Cav	Asteraceae
16.	*Hyptis brevipes* Poit	Lamiaceae
17.	*Hyptis capitata* Jack	Lamiaceae
18.	*Ipomea triloba* L.	Convolvulaceae
19.	*Mimosa invisa* Mart.ex. Colla	Leguminoceae
20.	*Mimosa pudica* (L.)	Leguminoceae
21.	*Momordica charantia* (L.)	Cucurbitaceae
22.	*Phyllanthus debilis* Klein ex Willd	Euphorbiaceae
23.	*Phyllanthus niruri* (Auct)	Euphorbiaceae
24.	*Polygonum longisetum* De Br	Polygonaceae
25.	*Portulaca oleracea* (L.)	Portulacaceae
26.	*Ricinus communis* (L.)	Euphorbiaceae
27.	*Phragmites karka* (Retz) Trus	Leguminoceae
28.	*Solanum torvum* SW	Solanaceae
29.	*Synedrella nodiflora* (L.) Gaertn	Asteraceae
30.	*Euphorbia hirta* (L.)	Euphorbiaceae
31.	*Euphorbia hypericifolia* (L.)	Euphorbiaceae
	Grasses	Family
32.	*Cynodon dactylon* (L.) Pers	Gramineae
33.	*Digitaria adscendes* (H.B.K) Henr	Gramineae
34.	*Digitaria ciliaris* (Retz) Koel	Gramineae
35.	*Echinochloa crusgalli* (L.) Beauv	Gramineae
36.	*Eleusine indica* (L.) Gaertn	Gramineae
37.	*Imperata cylindrica* (L.) Beauv	Gramineae
38.	*Panicum repens* (L.)	Gramineae
39.	*Paspalum distichum* (L.) Ridley	Gramineae
40.	*Setaria viridus* (L.) Beauv	Gramineae
	Sedges	Family
41.	*Cyperus iria* (L.)	Cyperaceae
42.	*Cyperus rotundus* (L.)	Cyperaceae

Observation of Variable

The variables were observed in this research include:

- Importance value of weed, calculated on 56 DAP with formula recomanded by Chaves and Bhadanari (1982):

$$\text{Relative density} = \frac{\text{number of individuals of species}}{\text{Total number of individual}} x\ 100\%$$

$$\text{Relative dominance} = \frac{\text{dominance of species}}{\text{dominance of all species}} x\ 100\%$$

$$\text{Relative frequency} = \frac{\text{frequency of species}}{\text{sum frequency of all species}} x\ 100\%$$

Importance value = Relatif density + relative dominace + relative frequency

- The plant height (cm), measured at the age of 14 and 28 day after planting (DAP).
- The leaf area (cm), measured at the age of 14 and 28 DAP.

- The length of the cob (cm) measured from the base to the tip of maize that contained the seed.
- The diameter of the cob (cm), measured by using a vernier caliper. The portions were measured namely the base, middle and lower end portions cob containing seed.
- The number of row seed cob^{-1}
- The number of seed cob^{-1}
- The dry weigth of 100 seeds
- The harvest index, calculated with formula:

$$\text{Harvest index} = \frac{\text{dry seed weight}}{\text{dry shoot weight}}$$

The weights stover (g) is taken by adding all dry ingredients crops other than dry seed.

- The shoot root ratio, calculated with formula recomanded by Farooq *et al.* (2003):

$$\text{The shoot root ratio} = \frac{\text{dry shoot weight (g)}}{\text{dry root weight (g)}}$$

Data Analysis

Data of each variable of maize were observed were analyzed by variance of analysis. If the F count is greater than the F table, than continued with Duncan Range Multiple Test (DRMT) at 95% of confidence level.

RESULT AND DISCUSSION

The Importance Value of Weed

The result identification of weeds on site of the research was obtained as such as 42 kinds of weed which comprises 31 species from broadleaf, 9 species from grasses and 2 species from sedges (Table 1). The dominance value for every kind of weeds in maize planting area age 14-56 DAP shown in Table 2. Based on the dominance of weeds at age 14 DAP as such as 96.14%, at the age of 28 DAP as such as 94.99%, at the age of 42 DAP as such as 98.66%, at the age of 56 DAP as such as 88.52%, and at the age of 70 DAP as such as 85.19%. At the age of 14 DAP there are 9 species of weed dominant from broadleaf namely: *M.invisa* (11.47%), *I.triloba* (10.29%), *P.longisetum* (6.07%), *R.communis* (5.64%), *M.charantia* (5.47%), *A.haustonianum* (4.02%), *P.niruri* (3.93%), *A.gracilis* (3.75%) and *C.plumieri* (3.75%). The kind of weed from grasses there are 3 species of dominant, namely: *D.adscendes* (4.15%), *C.dactylon* (3.67%) and *S.viridus* (3.58%). While the species of weed dominant from sedges is *C.iria* (2.96%). At the age of 28 DAP there are 11 species of dominant from broadleaf namely: *M.charantia* (9.67%), *I.triloba* (8.81%), *M.invisa* (6.90%), *S.torvum* (6:58), *P.oleracea* (5.67%), *R.communis* (3.88%), *A.gracilis* (3.77%), *P.niruri* (3.77%), *H.capitata* (3.70%), *C.plumieri* (3.47%) and

Table 2. Dominance value of weed (%) in maize planting area at 14-56 DAP

No.	Kind of weed	Observated at age				
	Broadleaves	14 DAP	28 DAP	42 DAP	56 DAP	70 DAP
1.	*Ageratum conyzoides* (L.)	0.08	0.05	0.07	0.05	0.00
2.	*Acalypha indica* (L.)	0.16	0.16	0.17	0.17	0.00
3.	*Ageratum haustonianum* Mill	4.02	1.81	1.90	1.85	1.25
4.	*Amaranthus gracilis* Desf	3.75	3.77	3.80	5.34	1.25
5.	*Bidens pilosa* (L.) Var Minor	2.06	1.92	1.97	3.56	1.19
6.	*Borreria alata* (Aubl.) DC	1.88	1.74	1.82	1.71	1.25
7.	*Centrosema plumieri* (Pers) Beath	3.75	3.47	5.48	1.85	2.88
8.	*Commelina nudiflora* (L.)	1.61	1.90	2.13	1.71	3.35
9.	*Cleome rutidospermae* DC	0.00	1.81	2.87	1.78	1.12
10.	*Galingsonga parviflora* Cav	2.06	1.89	1.90	1.71	2.88
11.	*Hyptis capitata* Jack	1.88	3.70	1.66	1.78	2.75
12.	*Ipomea triloba* (L.)	10.29	8.81	8.34	8.42	5.07
13.	*Eupatorium odorata* (L.)	1.79	3.12	1.97	1.83	3.60
14.	*Ruellia tuberosa* (L.)	0.05	0.05	0.06	0.07	0.00
15.	*Eupatorium peltescens* (L.)	1.44	2.26	1.82	1.83	1.25
16.	*Euphorbia hirta* (L.)	0.03	0.02	0.03	0.04	0.00
17.	*Euphorbia hypericifolia* (L.)	1.70	1.81	1.97	1.65	0.00
18.	*Mimosa pudica* (L.)	0.05	0.09	0.06	0.06	0.00
19.	*Mimosa invisa* Mart.ex. Colla	11.47	6.90	7.61	5.11	10.77
20.	*Momordica charantia* (L.)	5.47	9.67	5.28	5.46	5.53
21.	*Phyllanthus niruri* (Auct)	3.93	3.77	4.03	4.79	3.86
22.	*Polygonum longisetum* De Br	6.07	1.89	5.16	3.50	0.00
23.	*Portulaca oleracea* (L.)	1.97	5.67	3.56	1.71	3.53
24.	*Ricinus communis* (L.)	5.64	3.88	6.98	6.71	7.01
25.	*Solanum torvum* SW	2.53	6.58	3.80	3.56	5.35
26.	*Synedrella nodiflora* (L.) Gaertn	2.06	1.81	1.90	3.29	1.12
	Grasses					
27.	*Cynodon dactylon* (L.) Pers	3.67	3.55	3.41	3.43	5.14
28.	*Digitaria adscendes* (H.B.K.) Henr	4.15	3.70	3.96	1.78	1.45
29.	*Echinochloa colonum* (L.) Link	0.18	0.19	0.19	0.18	0.00
30.	*Echinochloa crusgalli* (L.) Beauv	1.89	1.59	1.90	2.96	0.00
31.	*Eleusine indica* (L.) Gaertn	0.19	0.17	0.19	0.17	0.00
32.	*Imperata cylindrica* (L.) Beauv	0.18	0.20	0.18	0.17	0.00
33.	*Panicum repens* (L.)	1.88	3.77	3.88	5.07	3.47
34.	*Paspalum distichum* (L.) Ridley	1.70	1.59	1.66	1.71	5.01
35.	*Setaria viridus* (L.) Beauv	3.58	1.66	5.01	3.43	3.60
	Sedges					
36.	*Cyperus iria* (L.)	2.96	0.00	1.90	1.83	1.51
37.	*Cyperus rotundus* (L.)	0.03	0.02	0.04	0.03	0.00
	Dominance value	96.14	94.99	98.66	88.52	85.19

E.odorata (3.12%). The weed from grasses there are 3 species of dominant, namely: *P.repens* (3.77%), *D.adscendes* (3.70%) and *C.dactylon* (3.55%). At the age of 42 DAP there are 10 species of weeds dominant from broadleaf namely: *I.triloba* (8.42%), *M.invisa* (7.61%), *R.communis* (6.98%), *C.plumieri* (5.48%), *M.charantia* (5.28%), *P.longisetum* (5.16%), *P.niruri* (4.03%), *A.gracilis* (3.80%), *S.torvum* (3.80%) and *P.oleracea* (3.56%). The species of weed from grasses there are 4 species of dominant namely: *S.viridus* (5.01%), *D.adscendes* (3.96%), *P.repens* (3.88%) and *C.dactylon* (3.41%). While the species of weeds dominant from sedges is *C.iria* (1.90%). At the age of 56 DAP there are 10 species of weeds dominant from broadleaf namely: *I.triloba* (8.42%), *R.communis* (6.71%), *M.charantia* (5.46%), *A.gracilis* (5.34%), *M.invisa* (5.11%), *P.niruri* (4.79%), *B.pilosa* (3.56%), *S.torvum* (3.56%), *P.longisetum* (3.50%) and *S.nodiflora* (3.29%). The kind of weed from grasses there are 3 species of dominant namely: *P.repens* (5.07%), *C.dactylon* (3.43%) and *S.viridus* (3.43%). While the species of weeds dominant from sedges is *C.iria* (1.83%). At the age of 70 DAP there are 8 species of weed dominant from broadleaf namely: *M.invisa* (10.77%), *R.communis* (7.01%), *M.charantia* (5.53%), *S.torvum* (5.35%), *I.triloba* (5.07%), *P.niruri* (3.86%), *E.odorata* (3.60%) and *C.nudiflora* (3.35%). The weed from grasses there are 4 species of weeds dominant namely: *C.dactylon* (5.14%), *P.distichum* (5.01%), *S.viridus* (3.60%) and *P.repens* (3.47%). While the species of weeds dominant from sedges is *C.iria* (1.51%).

because the soil surface is covered by a canopy. In addition, the types of weeds that have the potential to grow not stand in the shade. Although the kind of weeds to grow, but the growth of weeds become blocked due to the maize crop is already covered all the ground which were carried out with increasing plant height and addition of the dry weight of maize. According Fadhly and Fahdiana (2005), the presence of weeds in the planting area is relating to seed bank of weeds in the soil.

Plant Height

Application mycorrhiza fungi and bokashi fertilizer significanttly effect to the average height of maize at 28 DAP (Table 3). Application independently bokashi fertilizers age 14 DAP is presented in Table 4. Table 3 shows that the combination of mycorrhiza fungi and bokashi fertilizer affect the plant height at 28 DAP. At the level of B0, the plant highest obtained at the level of A0 that no significant with A1 and A2. At the level of B1, the plant highest obtained in combination with A1 that significantly different with A0 and A2. At the level of B2, the plant highest obtained in combination with A0 thats unreal different with level of A1 and A2. At the level of A0 the plant highest obtained in combination with level of B2 that significantly different with level of B0 and B1. At the level of A1 the plant highest obtained in combination with level of B1 that significantly different with level of B0 and B2.

Table 3. Effect of application mycorrhiza fungi and bokashi fertilizer to average height of maize (cm) at the age of 28 DAP

Mycorrhiza fungi	Bokashi fertilizer			DRMT 95%
	without bokashi fertilizer (B0)	15 kg plot^{-1} (B1)	22.5 kg plot^{-1} (B2)	
without mycorrhiza fungi propagules (A0)	63.54 a	85.30 b	110.16 a	2 = 20.11
10 g propagules planting hole^{-1} (A1)	52.23 a	135.13 a	102.06 a	3 = 21.08
15 g propagules planting hole^{-1} (A2)	59.47 a	83.91 b	106.02 a	

Note: The numbers are followed by the same letters in the same column, no significant based DRMT 95%.

Table 4. Effect of application bokashi fertilizer to average height of maize (cm) at the age of 14 DAP

Treatment	Plant height (cm)	DRMT 95%
without bokashi fertilizer (B0)	31.80 b	2 = 4.69
15 kg plot^{-1} (B1)	46.85 a	3 = 4.91
22.5 kg plot^{-1} (B2)	50.70 a	

Note: The numbers are followed by the same letters in the same column, no significant based DRMT 95%.

The dominance ratio number (NJD) of weeds at age 56 DAP is higher compared to all phases of observation (Table 2). The kind of weed from broadleaf are not found at the age of 14 DAP and begin to grow at 28 DAP is *C.rutidospermae*. This happens because the seeds of weed dormancy broke and stored in the soil forming sprout and grow into new individuals (Halim, 2012). The kind of weed from broadleaf that are not found at the age of 70 DAP are *A.conyzoides, A.indica, R.tuberosa, E.peltescens, E.hirta, E.hypericifolia, M.pudica,* and *P.longisetum*. The kind of weeds from grasses that are not found at the age of 70 DAP are *E.colonum, E.crusgalli, E.indica* and *I.cylindrica*. While the kind of weed from sedges is not found is *C.rotundus*. The emergence of new types of weeds at 56 DAP observations because the leaves do not cover the surface of the soil so that the seeds can still germinate weed and grow to form new individuals although growth began to slow in line with the increasing age of the plant (Halim, 2012). The number of weeds species were discovered at age 70 DAP less when compared with the 14, 28 and 56 DAP. The reduced the kind of weeds at the end of the study because the weed seeds that dormancy is not able to grow

At the level of A2 the plant highest obtained in combination with level of B2 that significantly different with level of B0 and B1. Table 4 shows that the plant highest at age of 14 DAP obtained in treatment of B2 that no significant with treatment of B1, but significantly different with treatment of B0. The results showed that the application of mycorrhiza fungi and bokashi fertilizer have different responses to average plant height (Table 2). At the beginning of growth, the roots of the plants are not infected by mycorrhiza fungi are perfectly so that the role of mycorrhiza fungi in the roots helps to broaden the nutrient absorption area has not gone well. According Talanca and Adnan (2005), infection of mycorrhiza fungi in the roots of host plants affected by root anatomy and age of the plant.

Leaf Area

The result of research showed that the application of mycorrhizal fungi and bokashi fertilizer are significantly effect on leaf area at 14 and 28 DAP (Table 5,6). Table 5 shows that mycorrhiza fungi at the level of A0 and A2, the highest leaf area obtained in combination with level of B2 were not significant with level of B1 and B2. At the level of A1 the highest leaf area obtained in combination with level B1 that were not significant with level of B2 but significantly different from with level of B0. The effect of mycorrhiza fungi and bokashi fertilizer on leaf area of maize age 28 DAP shown in Table 6. Table 6 shows that the application of mycorrhiza fungi and bokashi fertilizer affect on leaf area age 28 DAP on the level of bokashi (B0). The highest leaf area of maize obtained in combination with level of A2 where is significant with level of A0 and A1. At the level of B1 the highest leaf area obtained in combination with A0 that is significantly different with level of A1 and A2. At the level of B2 the highest leaf area obtained with combination of A0 that significantly different from with level of A1 and A2. At the level of mycorrhizal A0 and A2, the highest leaf area obtained at level of B2 that significantly different with level of B0 and B1. At the level of A1, the highest leaf area obtained with combination level of B1 that is significantly different with level B0 and B2.

Cob Diameter

The results of research showed that mycorrhiza fungi and bokashi fertilizer are not real effect on maize cob diameter. The independently mycorrhiza fungi and bokashi fertilizer are significantly affects on maize cob diameter (Table 8). Table 8 shows that the highest cob diameter obtained in the treatment of A1 that significantly different from with the treatment of A2, but no significant with treatment of A0. In bokashi fertilizer application independently, cob diameter highest obtained at treatment of B2 that had no significant with treatment of B1, but significantly different from treatment of B0. The treatment of the mycorrhiza fungi at the real effect independently (A1) indicated that at the time of entering a phase of generative growth of maize plants, the number of hyphae of mycorrhiza fungi that formed more so the effectiveness of the absorption of nutrients to support plant growth to be better (Table 8). Halim *et al*. (2015), states that the mycorrhiza fungi propagules can help improve the production of maize on marginal soils.

Table 5. Effect of application mycorrhiza fungi and bokashi fertilizer to average leaf area of maize (cm^2) at the age of 14 DAP

Mycorrhiza fungi	Bokashi fertilizer			DRMT 95%
	without bokashi fertilizer (B0)	15 kg plot^{-1} (B1)	22.5 kg plot^{-1} (B2)	
without mycorrhiza fungi propagules (A0)	5.05 a	10.05 a	15.18 a	2 = 9.32
10 g propagules planting hole^{-1} (A1)	4.60 a	16.56 a	14.02 a	3 = 9.77
15 g propagules planting hole^{-1} (A2)	5.79 a	11.06 a	12.83 a	

Note: The numbers are followed by the same letters in the same column, no significant based DRMT 95%.

Table 6. Effect of application mycorrhiza fungi and bokashi fertilizer to average leaf area of maize (cm^2) at the age of 28 DAP

Mycorrhiza fungi	Bokashi fertilizer			DRMT 95%
	without bokashi fertilizer (B0)	15 kg plot^{-1} (B1)	22.5 kg plot^{-1} (B2)	
without mycorrhiza fungi propagules (A0)	63.10 b	125.61 c	189.76 a	2 = 2.14
10 g propagules planting hole^{-1} (A1)	57.55 c	206.99 a	175.25 b	3 = 3.29
15 g propagules planting hole^{-1} (A2)	72.33 a	138.23 b	160.31 c	

Note: The numbers are followed by the same letters in the same column, no significant based DRMT 95%.

Table 7. Effect of application mycorrhiza fungi and bokashi fertilizer to average length of the cob maize (cm)

Mycorrhiza fungi	Bokashi fertilizer			DRMT95%
	without bokashi fertilizer (B0)	15 kg plot^{-1} (B1)	22.5 kg plot^{-1} (B2)	
without mycorrhiza fungi propagules (A0)	7.91 a	6.56 b	9.63 a	2 = 1.79
10 g propagules planting hole^{-1} (A1)	6.64 a	9.46 a	10.09 a	3 = 1.89
15 g propagules planting hole^{-1} (A2)	5.90 b	8.32 a	8.69 a	

Note: The numbers are followed by the same letters in the same column, no significant based DRMT 95%.

Length of the Cob

The results of research showed that mycorrhiza fungi and bokashi fertilizer significantly affected the length of the corn cob (Table 7). Table 7 shows that mycorrhiza fungi and bokashi fertilizer significantly affected to the length cob of maize. The longest cob obtained on level of A0 with combination with level of B0, which is not significant with level of A1 and BO, but significantly different with level of A2 and B0. At the level of B1, the longest cob obtained in combination with level of A1, which is not significant with level of A2, but significantly different from with level of A0. At the level of B2, the longest cob obtained in combination with the level of A1 that is not significant with the level of A0 and A2. At the level of A0, the longest cob obtained in combination with B2 that is not different from with level of B0, but significantly different from with level of B1. At the level of A1 and A2, the longest cob obtained in combination with level of B2 that is not different from with level of B1 but it is significantly different with level of B0.

While, the quantity of nutrients and nutrient balance derived from bokashi fertilizer causing the good performance growth and yield of maize (Karimuna *et al*., 2012).

Number of Row Seed Cob^{-1}

The result of research showed that the combination of mycorrhiza fungi and bokashi fertilizer were no real effect on the number of row seed cob^{-1}. The application of bokashi fertilizer independently significant affect on the number of row seed cob^{-1} (Table 9).

Table 9 shows that the highest number of seed rows obtained in the treatment of B2 which significantly different from with the treatment of B0 and B1. The treatment of B1 had no significant with the treatment of B0. This shows that the higher the dose of bokashi fertilizer, the better to improve yield of maize.

Number of Seed Cob^{-1}

The result of research showed that the combination of mycorrhiza fungi and bokashi fertilizer significant effect on the number of seed cob^{-1} (Table 10). Table 10 shows that the highest number of seeds obtained at the level of B0 and B2 in combination with level of A0 that is not significant with level of A1 and A2. In the level of B1 the highest number of seeds obtained in combination with A1 that significant different with level of A2, but it is not significantly different from with the level of A0. In the level of B2 the highest number of seeds obtained in combination with the level of A0 that it is not significantly different from level of A1, but it is significantly with level of A2. At the level of mycorrhiza fungi (A0 and A1), the highest number of seeds obtained in combination with the level of B2 that it is significantly different with the B0 and B1. In the level of A2, the highest number of seeds obtained in combination with the level of B2 that it is not significantly with the level of B1, but it is significantly different with the level of B0. This shows that mycorrhiza fungi are not effective to improve crop yields of maize when the soil contains a lot of organic matter. obtained at the level of A2 that is significantly different with the level of A0 and A1. The highest dry weight of 100 seeds plant^{-1} at the level of B1 was obtained in combination with the level of A1 that is not significantly with the level of A2, but significantly different from with the level of A0. The highest dry weight of 100 seeds plant^{-1} at the level of B2 obtained in combination with the level of A0 that is not different from with the level of A1 and A2. The dry weight of 100 seeds plant^{-1} at the level of A0 obtained in combination with the level of B2 that is significantly different from with the level of B0 and B1. At some level A1 dry weight of 100 grains highest obtained in combination with B1 are not significant with B2 but significantly different from the B0, while at level A2 dry weight of 100 grains highest obtained in combination with level B2 mutually no significant with B1 and B0. The result of research that the highest of average number of seed cob^{-1} and dry weight of 100 seeds obtained in combination with without mycorrhiza fungi and bokashi fertilizer as 22.5 kg each plot (A0B2). Application of bokashi fertilizer as 22.5 kg each plot without mycorrhiza fungi are considered able to increase the number of seed cob^{-1} and dry weight of 100 seed (Table 11).

Table 8. Effect of independently of mycorrhiza fungi and bokashi fertilizer to average diameter of the cob maize (cm)

Mycorrhiza fungi	Cob diameter (cm)	DRMT 95%
without mycorrhiza fungi propagules (A0)	2.40 a	2 = 0.162
10 g propagules planting hole^{-1} (A1)	2.45 a	3 = 0.170
15 g propagules planting hole^{-1} (A2)	2.21 b	
Bokashi fertilizer	Cob diameter (cm)	DRMT 95%
without bokashi fertilizer (B0)	2.18 b	2 = 0.162
15 kg plot^{-1} (B1)	2.41 a	3 = 0.169
22.5 kg plot^{-1} (B2)	2.47 a	

Note: The numbers are followed by the same letters in the same column, no significant based DRMT 95%.

Table 9. Effect of bokashi fertilizer to average number of row seed cob^{-1}

Treatment	number of row seed cob^{-1}	DRMT 95%
without bokashi fertilizer (B0)	20.85 b	2 = 2.01
15 kg plot^{-1} (B1)	22.30 b	3 = 2.11
22.5 kg plot^{-1} (B2)	24.82 a	

Note: The numbers are followed by the same letters in the same column, no significant based DRMT 95%.

Table 10. Effect of mycorrhiza fungi and bokashi fertilizer to average number of seed cob^{-1}

Mycorrhyza fungi	Bokashi fertilizer			DRMT 95%
	without bokashi fertilizer (B0)	15 kg plot^{-1} (B1)	22.5 kg plot^{-1} (B2)	
without mycorrhiza fungi propagules (A0)	129.00 a	89.33 b	246.78 a	2 = 46.20
10 g propagules planting hole^{-1} (A1)	91.00 a	190.44 a	239.33 a	3 = 48.45
15 g propagules planting hole^{-1} (A2)	87.44 a	186.33 a	192.56 b	

Note: The numbers are followed by the same letters in the same column, no significant based DRMT 95%.

Table 11. Effect of mycorrhiza fungi and bokashi fertilizer to average dry weight of 100 seeds plant^{-1} (g)

Mycorrhiza fungi	Bokashi fertilizer			DRMT95%
	without bokashi fertilizer (B0)	15 kg plot^{-1} (B1)	22.5 kg plot^{-1} (B2)	
without mycorrhiza fungi propagules (A0)	17.11 c	17.84 b	24.50 a	2 = 2.84
10 g propagules planting hole^{-1} (A1)	19.78 b	24.00 a	23.07 a	3 = 2.98
15 g propagules planting hole^{-1} (A2)	22.92 a	21.71 a	24.11 a	

Note: The numbers are followed by the same letters in the same column, no significant based DRMT 95%.

Dry Weigth of 100 Seeds Plant^{-1}

The result of research showed that the combination of mycorrhiza fungi and bokashi fertilizer significant effect on the dry weight of 100 seeds plant^{-1} (Table 11). Table 11 shows that the combination of mycorrhiza fungi and bokashi fertilizer significantly affected the dry weight of 100 seeds plant^{-1}. In the level of B0 the highest dry weight of 100 seeds plant^{-1}

Allegedly with bokashi fertilizer high doses crop nutrient needs can be met. The amount of nutrients available to plants in sufficient quantities, the plant growth and development goes well. The physiological activity of the plant will take place properly depending on the availability of nutrients in the media and plant tissues, so it can determine the proportion of revenue sharing assimilation in organs roots, stems and leaves.

Table 12. Effect of mycorrhiza fungi and bokashi fertilizer to the average harvest index of maize

Mycorrhiza fungi	Bokashi fertilizer			DRMT 95%
	without bokashi fertilizer (B0)	15 kg plot^{-1} (B1)	22.5 kg plot^{-1} (B2)	
without mycorrhiza fungi propagules (A0)	0.15 a	0.10 c	0.20 a	2 = 0.05
10 g propagules planting hole^{-1} (A1)	0.20 a	0.14 b	0.22 a	3 = 0.06
15 g propagules planting hole^{-1} (A2)	0.15 a	0.23 a	0.19 a	

Note: The numbers are followed by the same letters in the same column, no significant based DRMT 95%.

Table 13. Effect of bokashi fertilizer to average of shoot root ratio of maize

Treatment	Shoot root ratio	DRMT 95%
without bokashi fertilizer (B0)	1.85 b	2 = 0.36
15 kg plot^{-1} (B1)	2.28 a	3 = 0.38
22.5 kg plot^{-1} (B2)	2.56 a	

Note: The numbers are followed by the same letters in the same column, no significant based DRMT 95%.

Harvest Index

The result of research showed that the combination of mycorrhiza fungi and bokashi fertilizer significant effect on the harvest index (Table 12). Table 12 shows that the combination of mycorrhiza fungi and bokashi fertilizer effect on harvest index at the level of B0 and B2. The highest harvest index obtained in combination with level of A1 that it is not significantly different with level of A0 and A2. At the level of B1, the highest harvest index obtained in combination with level of A2 that significantly different with level of A0 and A1. At the level of A0 and A1, the highest harvest index obtained in combination with level of B2 that it is not significantly different with the level of B0, but significantly different from with the level of B1. At the level of A2, the highest harvest index obtained in combination with the level of B1 that it is not significantly different with the level of B2, but significantly different from with the level of B0. The results showed that the average length of the cob and the highest harvest index obtained in combination A1B2 and A2B1 (Table 7, Table 12). It is suspected mycorrhizal fungi and bokashi fertilizer can complement each other in supporting growth and crop production. The mycorrhiza fungi play a role in increasing the tolerance of crops to the critical condition of the land (Halim *et al*., 2015), while the bokashi fertilizer containing nutrients and nitrogen source for plant growth (Karimuna *et al*., 2012).

Shoot Root Ratio

The result of research showed that the combination of mycorrhizal fungi and bokashi fertilizer does not affect to the shoot root ratio. The bokashi fertilizer independently significants effect on the shoot root ratio (Table 13). Table 11 shows that the highest of shoot root ratio obtained at treatment of B2 that it is not significant with the treatment of B2, but it is significantly different from with treatment of B0. This indicates that the doses of bokashi fertilizers are very affect to root shoot ratio than without the application of fertilizers.

Conclusion

Based on the dominance value of weed at age 14 DAP as such as 96.14%, at the age of 28 DAP as such as 94.99%, at the age of 42 DAP as such as 98.66%, at the age of 56 DAP as such as 88.52%, and at the age of 70 DAP as such as 85.19%. Combination of mycorrhiza fungi and bokashi fertilizer improve the growth and yield of maize on plant height at age 28 DAP, leaf area at age 14 and 28 DAP, cob length, number of seeds cob^{-1}, dry weight of 100 seed and harvest index. Independently treatments of mycorrhiza fungi give better effect to the highest the cob diameter obtained on treatment of 10 g propagules planting hole^{-1} (A1). Independently treatment of bokashi fertilizer provide better real effect on plant height at 14 DAP, cob diameter, number of rows seeds and shoot root ratio highest obtained in treatment of B2. The application of bokashi fertilizer as 22.5 kg plot^{-1} (B2) gives the best results to the production of dry seed of maize.

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