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Growth Response and Yield of Maize and Soybean in Intercropping to the Urban Waste Compost And Rock Phosphate

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Abstract: ***The research aims to study the growth response and yield of maize and soybean in intercropping to the using of urban waste compost and rock phosphate. This research was conducted at Sei Dadap Village, Asahan district, Province North Sumatera from May to September 2010. This research was compilled use Randomised Complete Design with two factors and three replications. The first factor is the using of urban waste compost with four level, i.e 0.0 ton ha^{-1}, 10 ton ha^{-1}, 20 ton ha^{-1}, and 30 ton ha^{-1}. The second factor is using of rock phosphate in three level, i.e 0.0 ppm P, 50 ppm P, and 100 ppm P. The results shown using of urban waste compost up to 30 ton ha^{-1} and rock phosphate up to 100 ppm P increase the height of plant, either on maize in observation 2, 4 and 6 weeks after plant or soybean in age of 10, 20, and 30 days after plant, stimulate the flowering for maize, the weight of 1,000 dried grain and yield of dried grain per plot as well as the increasing of the number of branch per plant, weight of 100 dried grain and production of dried grain soybean per plot.***

Keywords: compost, phosphate, maize, soybean, intercropping

1. Introduction

The availability of staple foods such as rice and other crops (corn and soybeans) at this time is not favorable for the survival of the national food resilience. Breakthrough and efforts to increase food production has been taken by the government through its main business such as intensification of agricultural development, extension, rehabilitation, and diversification (multiple cropping / variety) (Jumin, 2005; Moenandir, 2004).

One effort to increase the productivity of crops is to diversify by planting two or more crops are grown simultaneously on the same piece of land. This pattern is known as intercropping. Planting two or more crops a season-long planted simultaneously with spacing irregular shapes and lines that criss-cross for each type of plant in one area called a pattern intercropping a season (intercroping), and when apart in age plants called a pattern of intercropping different age (interplanting) (Arsyad, 2010; Dja'far *et al.* 1990).

Planting corn and soybean intercropped one season can increase production per unit area. Reported that the national maize production increased in the period of 5 years (from 2000 to 2005) amounted to 35.21%. Similarly, in North Sumatra increased 10.30% and Asahan (2002 to 2006) increased 17.86%. But for soybean production nationally, in the same year decreased 20.56%, but in North Sumatra increased 22.96% and 65.38% decrease in Asahan (Purwono dan Purnawati, 2007; Asahan Dalam Angka, 2007).

Many factors effect the productivity of crops in the field, among others, is largely determined by genetic factors crops, farm management / technical culture and environment. Environmental factors crops are generally divided into two groups, namely soil and climate. In general, land is relatively easy to manage compared with the climate. Factors soil is very influential among fertility factors, physical, chemical, and biological soil. Another factor is the land characteristics and the specific nature of the soil. (Winarso, 2006; Tisdale *et al.* 1993).

Other things, the material amelioration such organic materials, especially municipal waste in short supply in many places, which can be used for making compost Bokashi in order to improve soil fertility and quality. In addition in rural areas are often found livestock manure, both groups of ruminants and poultry that can be used as Bokashi fertilizers like cow manure, goat manure and chicken manure. (Dja'far *et al.,* 1990; Jumin 2005; Higa, 1997; Salikin, 2003).

In addition to organic matter, fertilizer becomes imperative in increasing agricultural production. Reported availability of P in the mineral acidic soils are constraints that can limit crop production. From various trials conducted both in plantations or in the area of agriculture, both on land, rice fields, or tidal land, turns giving P fertilizer affect the increasing and quality of corn and soybean seeds. As is known in physiology P important in the transfer of energy in the body of plants and Ca is involved in the formation of cell walls (Ca-pectat) (Mengel and Kirby, 1982; Tisdale *et al.,* 1993).

Expected Bokashi urban waste that is combined with Rock Phosphate fertilizer on corn and soybean crops with intercropping patterns can increase crop productivity. Additional combination pattern of these plants (monocots and dicots) with different root systems will reduce competition in acquiring nutrients and water from the soil. Based on the explanation and description above, the growth and production response research of corn and soybean intercropped against Bokashi composting of municipal solid

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waste and Rock Phosphate implemented. This study aims to determine the growth and production of maize and soybean in intercropping against Bokashi urban waste and Rock Phosphate.

2. Methods

This research was conducted at Sei Dadap Village, Sei Dadap Subdistrict, Asahan district, Province North Sumatera in the elevation 25 masl, sand clay soil texture, and acidic soil with pH 4.8. Soil character analysis was conducted in the soil and plant laboratory of PPK Medan from May to September 2010.

This research compilled use Randomised Complete Design factorial with two factors and three replication. The first factor is the using of urban waste compost with four level, i.e 0.0 ton ha^{-1} (control), 10 ton ha^{-1}, 20 ton ha^{-1}, and 30 ton ha^{-1}. The second factor is using of rock phosphate in three level, i.e 0.0 ppm P (control), 50 ppm P, and 100 ppm P. The observation variabel are the height of plant, flowering age, weight of 1,000 dried grain and production af dried grain per plot for crops and the height of plant, the number of branch per plant, weight of 100 dried grain and production of dried grain of soybean per plot for soybean.

Implementation research begins with the first and second tilling. Once processed, made research plots. The size of the research plots were made with a length of 2.40 m, width 2.10 m (wide plot = 5.04 m^2) with 3 replications. There are 12 plots each replication. The distance between the replicates 1 m and 0.5 m spacing between plots.

Before planting, seed treatment is done, how the seeds were treated Ridomil 35 primary SD, in order to prevent downy mildew. Seeding is done by sowing at a depth of 3 cm 2 grains per hole. Spacing 70 cm x 40 cm, good for both corn and soybean seed. At the age of 1 week after planting is done by leaving a kind of selection of plants whose growth is more robust than any hole.

Bokashi compost fertilizer treatment of urban waste, given the current second land preparation in order to make Bokashi compost is applied evenly and can provide a response in plants and soils. Bokashi composting are given the appropriate dose based on the water content of Bokashi (60%) respectively (S1 = 8 kg per plot, S2 = 16 kg per plot, and S3 = 24 kg per plot). Provision of rock phosphate was performed 1 week before planting, in the array, each plot is given the appropriate treatment has been determined, respectively (P1 = 215g per plot RP and RP P2 = 600 g per plot).

Corn harvest is done by harvesting criteria, has been aged in accordance descriptions, husks yellow, when peeled rind, corn sprouts look dry and shiny. Then, the dried corn seeds 3-4 days to obtain seed moisture content 9-11%. Soybean harvest is done with the characteristic yellow-brown pods have been evenly, the leaves have a lot to dry and fall off, the stem dried, age appropriate description, carried out by cutting the main stem just above the soil surface, then dried until the moisture content reaches 14-16% to facilitate pembijian.

For maize, the observed variables were plant height (cm), days to flowering (days), weight 1,000 dry seed grain seeds (g), the production of dry seed corn seed per plot (kg). For the soybean crop, the observed variables were plant height (cm), number of branches per plant (branches per plant), weight of 100 grains of dry seed seeds (g), the production of dried soybean seeds per plot (kg).

3. Results

High Maize

Table 1 shows there are significant Bokashi urban waste and RP singly (S) and (P) to the observation of high growth of maize plants planted with soybeans. Bokashi urban waste aplication with a dose of 30 ton ha^{-1} can promote the growth of the corn plant height, for observation of 2, 4, and 6 weeks after planting when compared to controls (S0) as well as with other treatments (S1 and S2). When compared to the high growth of corn plants with the highest Bokashi urban waste aplication a dose of 30 ton ha^{-1} (S3) with a control (S0) there is an increase of plant height increment each for observation 2, 4, 6 weeks after planting (WAP) at 30.43 %, 25.61% and 15.09%.

RP Giving a dose of 100 ppm P (P2) on the high growth of corn plants show significantly different from the control (P0) but not significantly different than the other treatments (P1), both for observation 2, 4, and 6 weeks after planting. When compared to the average height increase of corn plants with the treatment of the RP 100 ppm P per plot (P2) with the control (P0) there is increased growth of corn plant height respectively 6.44%, 3.57%, and 31.31% for observation 2, 4, and 6 weeks after planting.

Table 1: Response of Maize High Growth In Intercropping Against Granting Bokashi Municipal Solid Waste and Rock Phosphate (cm)

Treatment	High Maize (cm)		
	2 WAP	4 WAP	6 WAP
Bokashi Urban waste			
S0	24.58 c	80.27 c	182.72 c
S1	26.27 c	81.15 bc	184.24 c
S2	29.00 b	86.53 b	193.73 b
S3	32.06 a	100.83 a	210.30 a
Rock Phosphate			
P0	27.16 b	85.41 b	186.90 d
P1	27.86 ab	87.71 ab	195.93 a
P2	28.91 a	88.46 a	195.41 a
CV (%)	4.40	2.88	2.58

Description: Figures followed by the same letter on the same line showed no significant differences in the level of 5% using HSD

High Soybean Plants

Table 2 shows there are significant effect Bokashi urban waste singly (S) and (P) to the observation of high growth of soybean plants grown in intercropping with maize. Giving Bokashi urban waste with a dose of 30 ton ha^{-1} (S3) to the high growth of soybean plants for observation 10, 20, and 30 days after planting (DAP) showed significantly different compared with controls (S0) and other treatment (S1 and

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S2). There is an increase in high-growth soybean crops respectively by 22.02%, 69.13%, and 64.16% for the observations 10, 20, and 30 days after planting.

RP Giving a dose of 100 ppm P (P2) on the high growth of soybean plants for observation 20, and 30 days after planting showed significantly different compared with controls (P0), except for the observation of 10 days after planting. When compared to the average height of soybean plants with applications RP 10 ppm P (P2) with the control (P0) there is increased as height of soybean plants respectively by 6.82% and 11.08% for the observation of 20 and 30 days after planting.

Table 2: High Growth Response of Soybean Plants In Intercropping Against Bokashi Urban Waste Application and Rock Phosphate (cm)

Treatment	High Soybean Plant (cm)		
	10 DAP	20 DAP	30 DAP
Bokashi Urban waste			
S0	12.49 b	17.72 d	26.84 d
S1	12.97 b	23.16 c	33.11 c
S2	13.49 b	26.20 b	37.52 b
S3	15.24 a	29.97 a	44.06 a
Rock Phosphate			
P0	13.37 a	23.46 b	33.47 c
P1	13.38 a	24.27 b	35.50 b
P2	13.87 a	25.06 a	37.18 a
CV (%)	5.55	3.69	2.39

Description: Figures followed by the same letter on the same line showed no significant differences in the level of 5% using HSD

Age Flowering Maize

Table 3 shows that there are effects of Bokashi urban waste application and RP singly (S) and (P) on the observation date of flowering plants grown maize intercropped with soybeans. Applications Bokashi urban waste at a dose of 30 ton ha^{-1} (S3) to the age of flowering maize plants were significantly different when compared to the control (S0) which are accelerated decreasing of the release of interest in maize valued at 7.63% (44 days).

Table 3: Response Age Flowering Maize In Intercropping Against Bokashi Urban Waste Application and Rock Phosphate (Days)

Treatment Bokashi Urban Waste (kg per plot)	Average Flowering Date (days)	Rock Phosphate (g per plot)	Average Flowering Date (days)
S0	58.22 a	P0	57.58 a
S1	56.33 b	P1	55.92 b
S2	55.67 c	P2	54.50 c
S3	53.78 d		
CV (%)	1.25		

Description: Figures followed by the same letter on the same line showed no significant differences in the level of 5% using HSD

RP Giving a dose of 100 ppm P (P2) to the observation date of flowering plants corn showed significantly different compared with controls (P0) and other treatment (P1). When compared to the average age of the flowering plant corn with the provision of the RP 100 ppm P (P2) to the control (P0) are accelerating the release of the flowers of maize valued at 5.35% (3.38 days).

Number of Branches Per Soybean Crop

Table 4 shows the effect of Bokashi urban waste and RP singly (S) and (P) to the observation number of branches per plant soybeans were planted with corn. Applications Bokashi urban waste at a dose of 30 ton ha^{-1} (S3) to the number of branches per plant soybean was significantly different compared with controls (S0) and the two other treatments (S1 and S2). When compared with Bokashi urban waste application with a dose of 15 ton ha^{-1} (S3) with a control (S0) there is an increasing number of branches per plant soybeans valued at 32.52%.

Table 4: Response Number of Branches Per Soybean Crop (NBPSC) In Intercropping Against Bokashi Urban Waste Application and Rock Phosphate

Treatment Bokashi Urban Waste (kg per plot)	NBPSC	Rock Phosphate (g per plot)	NBPSC
S0	3.49 c	P0	3.73 b
S1	3.63 bc	P1	3.92 ab
S2	3.98 b	P2	4.18 a
S3	4.66 a		
CV (%)	6.72		

Description: Figures followed by the same letter on the same line showed no significant differences in the level of 5% using HSD

RP Giving a dose of 100 ppm P (P2) to the number of branches per plant soybeans showed significantly different compared with controls (P0), but did not differ significantly from the other treatments (P1). When compared with the provision of the RP 100 ppm P (P2) with the control (P0) there is an increasing number of branches per plant soybeans at 12.06%.

Weight of 1,000 grains of shelled corn seeds

Table 5 shows the application Bokashi urban waste at a dose of 30 ton ha^{-1} (S3) was significantly different compared to control (S0) and the two other treatments (S1 and S2). When compared with the provision of Bokashi urban waste with a dose of 30 ton ha^{-1} (S3) with a control (S0) there is an increasing weight of 1,000 grains of dry seed corn seeds worth 33.52%.

Table 5: Response Weight of 1,000 grains of Shelled Corn Seeds (SCS) In Intercropping Against Bokashi Urban Waste Application and Rock Phosphate (g)

Treatment Bokashi Urban Waste (kg per plot)	Weight 1,000 SCS (g)	Rock Phosphate (g per plot)	Weight 1,000 SCS (g)
S0	252.15 d	P0	260.30 c
S1	258.41 c	P1	262.80 b
S2	266.52 b	P2	265.34 a
S3	274.17 a		
CV (%)	0.44		

Description: Figures followed by the same letter on the same line showed no significant differences in the level of 5% using HSD

RP Giving a dose of 100 ppm P (P2) to the weight of 1,000 grains of dry seed corn seeds showed significantly different

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compared with controls (P0) and other treatment (P1). When compared with the RP application at a dose of 100 ppm P (P2) with the control (P0) there is an increasing weight of 1,000 grains of dry seed corn seeds worth 1.94%.

Dry weight of 100 grains Soybean Seeds

Table 6 shows the application of Bokashi urban waste at a dose of 30 ton ha^{-1} (S3) significantly affects the weight of 100 grains of dry seeds as compared to the control (S0) and the two other treatments (S1 and S2). When compared to Bokashi urban waste application with a dose of 30 ton ha^{-1} (S3) with a control (S0) there are increasing to the weight of 100 grains dry beans soybeans at 23.73%.

Table 6: Response Dry Weight of 100 grains Soybean Seeds (GSS) In Intercropping Against Bokashi Urban Waste Application and Rock Phosphate (g)

Treatment Bokashi Urban Waste (kg per plot)	Dry Weight 100 GSS (g)	Rock Phosphate (g per plot)	Dry Weight 100 GSS (g)
S0	9.23 c	P0	9.83 b
S1	9.69 c	P1	10.13 ab
S2	10.28 b	P2	10.50 a
S3	11.42 a		
CV (%)	2.78		

Description: Figures followed by the same letter on the same line showed no significant differences in the level of 5% using HSD

RP Giving a dose of 100 ppm P (P2) to the weight of 100 grains of dry soybean seeds showed significantly different compared with controls (P0), did not differ significantly with other treatments (P1). When compared with 100 ppm P RP (P2) to control the weight of 100 grains of dry soy beans there was an increase of 6.82%.

Dried corn shelled Seed Production Per Plot

Table 7 shows the application Bokashi dose of 30 ton ha^{-1} (S3) on the production of dry shelled seeds per plot significant effect compared to control (S0) and the two other treatments (S2). When compared to Bokashi urban waste application with a dose of 30 ton ha^{-1} (S3) with a control (S0) there is an increased production of dry shelled corn seed per plot 64.15%.

Giving RP at a dose of 100 ppm P (P2) on seed production in dry seed corn per plot showed significantly different when compared with controls (P0) there is an increased production of seed shelled maize by 20%, but the application of RP 50 ppm P (P1) did not differ significantly with the control (P0).

Table 7: Response Dried Corn Shelled Seed Production Per Plot (DCSSP) In Intercropping Against Bokashi Urban Waste Application and Rock Phosphate (g)

Treatment Bokashi Urban Waste (kg per plot)	DCSSP per plot (g)	Rock Phosphate (g per plot)	DCSSP per plot (g)
S0	0.53 d	P0	0.65 b
S1	0.68 c	P1	0.71 b
S2	0.77 b	P2	0.78 a
S3	0.87 a		
CV (%)	4.71		

Description: Figures followed by the same letter on the same line showed no significant differences in the level of 5% using HSD

Dried Soybean Seed Production Per Plot

Table 8 shows the application of Bokashi urban waste at a dose of 30 ton ha^{-1} on the production of dry seeds of soybean per plot was significantly different compared with controls (S0) and the two other treatments (S1 and S2). When compared to Bokashi urban waste application with a dose of 30 ton ha^{-1} (S3) with a control (S0) there is an increased production of dry seeds of soybean per plot 34.78%.

RP Giving a dose of 100 ppm P (P2) on the production of dry seeds of soybean per plot showed significantly different compared with controls (P0) was not significantly different to other treatments (P1). When compared with the RP giving a dose of 100 ppm P (P2) with the control (P0) there is an increased production of dry beans per plot 12%.

Table 8: Response Dried Soybean Seed Production (DSSP) Per Plot In Intercropping Against Bokashi Urban Waste Application and Rock Phosphate (g)

Treatment Bokashi Urban Waste (kg per plot)	DSSP per plot (g)	Rock Phosphate (g per plot)	DSSP per plot (g)
S0	0.23 c	P0	0.25 b
S1	0.25 bc	P1	0.27 ab
S2	0.27 b	P2	0.28 a
S3	0.31 a		
CV (%)	3.88		

Description: Figures followed by the same letter on the same line showed no significant differences in the level of 5% using HSD

4. Conclussion

Applications Bokashi urban waste up to the dose of 30 ton ha^{-1} on the ground mineral acid can increase the growth of high corn and soybean crops intercropped, both the observation 2, 4, 6 weeks after planting for corn age of 10, 20, and 30 days after planting , as well as to accelerate the release of soybean plants flowers of maize, increase the weight of 1,000 grains of seed and dry seed corn seed production per plot and increase the number of branches per plant, weight of 100 grains dry beans and soybean seed production per plot when compared to controls.

Giving rock phosphate at a dose of 100 ppm P in soil mineral acid can increase the growth of high corn and soybean crops intercropped, both the observation 2, 4, and 6 weeks after planting for corn and observations 20 and 30 days after planting for soybeans accelerate discharge of interest in maize, increase the weight of 1,000 grains of seed and dry seed corn seed production per plot and increase the number of branches per plant, weight of 100 grains dry beans and dry beans soybean production per plot compared with controls.

Applications Bokashi urban waste up with a dose of 30 ton ha^{-1} on acid mineral soil with low soil organic matter content can increase the production of maize seeds worth 0.87% 1.4 kg m^{-2} (equivalent to 6.21 ton ha^{-1}) , an increase of 63.85%

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compared with controls, lower 21.35% compared with the description. As for the production of soybean seeds can increase yield per plot valued at 0.31 kg (equivalent to 1.11 ton ha^{-1}), an increase of 35.37% compared with controls, lower 53.75% compared with the description.

Rock phosphate applications up to 100 ppm P in the soil minerel acid with a pH of 4.8 and P provided enough can increase corn production kg per plot of 0.78% (equivalent to 5.57 ton ha^{-1}), an increase of 20.04% compared to control, 28.59% lower than a description, whereas for soybean seed production can increase the yield of 0.28 kg of 2.8 m 2 (equivalent to 1.00 ton ha^{-1}), an increase of 12.36% compared with controls, more 58.27% lower compared with the description.

5. Future Scope

Need to do the research on growth and yield response of maize and soybean intercropping against Bokashi urban waste treatment and rock phosphate suitable cropping patterns prevailing in an area. Need to do the research on growth and yield response of maize and soybean intercropping against Bokashi composting remains of other agricultural produce with rock phosphate.

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