Effects of Fertilizers on Yield Of Indigenous Vegetables

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Abstract

The objective of this research was to study the effect of fertilizers on plant growth and productivity of several indigenous vegetables. Four kinds of indigenous vegetables were used in this research, i.e. beluntas, katuk, kenikir, and kemangi. The experimental design was Completely Randomized Block Design with three replications, in which four fertilizing treatments (P0: without fertilizer; P1: manure; P2: Urea+SP36+KCl; and P3: manure+Urea+SP36+KCl) applied were used in each experiment. The results showed that compared to the other commodities, the combination of organic and inorganic fertilizer (chicken manure + Urea+SP36+KCl) gave the highest number of branches and leaves in kemangi. Compared to other treatments, the Urea+SP36+KCl treatment showed the highest fresh weight yield of beluntas, kenikir and kemangi. All fertilizer treatments in katuk did not affect the number of branches, branch length, number of leaves, and yield.

INTRODUCTION

Indigenous vegetables are local vegetables known and consumed by people in certain area. They are adapted well in specific environment. They function as source of proteins, vitamins, and minerals. Therefore, the availability of indigenous vegetables plays an important role in fulfilling standard vegetable consumption. Currently, in Indonesia vegetable consumption per capita is 34.5 kg/ year. Meanwhile the FAO standard of vegetable consumption per capita is 65.0 kg/year. (Departemen Pertanian, 2008). Among those indigenous vegetables, beluntas (*Pluchea indica* (L) Less), katuk (*Sauropus androgynus* L. Merrill), kenikir (*Cosmos caudatus* Kunth), and kemangi (*Ocimum americanum* L) are potential to be developed as alternative vegetables to fulfill nutrition and medicinal need as well as market demand (Kusmara and Suryadi, 2004).

Fertilizer is an important factor in cultural practice of vegetable crops. Nitrogen (N) has role in growth of leaf, shoot and root, and causes greener leaf (Soepardi, 1983; Kastono et al. (2005). Phosphorus (P) is part of nucleus which plays important role in cell division and meristem development (Sarief, 1986). Tisdale et al. (1985) stated that potassium (K) has role in plant metabolism. It functions as component of enzymes.

In general, there are two kinds of fertilizer namely inorganic and organic. Fertilizers can be classified based on number of nutrients, i.e. single and compound

fertilizer. Leiwakabessy dan Sutandi (2004) stated that fertilizer supports growth, increases yield and quality. Subhan et al. (2008) reported that application of NPK (50 kg/ha N, 75 kg/ha P_2O_5, and 75 kg/ha K_2O) increased height, diameter, and yield of tomato per plot. FAO (2005) reported that the dominant inorganic fertilizers produced and used in Indonesia are urea, TSP (triple superphosphate, 46 percent P_2O_5), AS (ammonium sulphate, 21 percent N and 24 percent S) and KCl (potassium chloride, 60 percent K_2O). More recently Indonesia replaced TSP with SP36 (superphosphate, 36 percent P2O5) and produced the compound fertilizer Ponska (15 percent N, 15 percent P_2O_5 and 15 percent K_2O).

Organic materials are very important for maintaining soil fertility in a tropical country such as Indonesia. One of organic fertilizer is manure. Livestock wastes, particularly chicken manure and cattle manure, have been applied by farmers for decades. It contains macro and micronutrients (Sarief, 1986). Suriatna (1988) stated beside addition of nutrient, manure also added organic matters which improve soil structure.

The objective of the research was to determine the effect of fertilization on growth and yield of several indigenous vegetables such as beluntas, katuk, kenikir, and kemangi.

MATERIAL AND METHODS

Experiments were conducted in SANREM Station in Nanggung, Leuwiliang from December 2007-July 2008. Materials used were seeds of kenikir and kemangi, cuttings of katuk and beluntas, urea, superphosphate (SP36), KCl, and chicken manure mixed with rice husk. Plot size was 4.0 m x 1,0 m. Plant spacing for kemangi, kenikir, and beluntas was 50 cm x 25 cm, while for katuk was 50 cm x 20 cm.

The experiment was arranged in Completely Randomized Block Design. Four experiments were conducted separately based on the tested commodities, i.e. beluntas, katuk, kemangi, and kenikir. Treatments were as follows: P0 (without fertilizers); P1 (Chicken manure 5 ton/ha); P2 (100 kg urea/ha, 135 kg SP36/ha, 135 kg KCl/ha); P3 (combination of organic (P1) and inorganic (P2) fertilizer). Each treatment was replicated three times.

Observation was made mainly on variables related to edible portion such as number of leaves and branches, length of branch, and yield per plant and yield per plot. Data was analyzed by SAS; when F test was significant, honestly significant difference (HSD) test was applied.

RESULTS AND DISCUSSION

Anova of fertilizer treatments on beluntas is presented in Table 1. Fertilizer treatments did not give significant effect on number of branches, length of branch, and number of leaves at 4-5 weeks after planting (WAP). However, they affected number of leaves at 7 WAP, yield per plant and yield per plot.

Table 1. Anova of fertilizer treatments on Beluntas

Variables	Observation at (WAP)				
	4	5	6	7	7-22
Number of branches	ns	ns	ns	ns	-
Length of branch	ns	ns	ns	ns	-
Number of leaves	ns	ns	ns	*	-

Yield/plant	-	-	-	-	**
Yield/plot	-	-	-	-	**

Note : WAP, weeks after planting; ns: non significant, F test at 5%; * Significantly difference, F test at 5%; ** Significantly difference, F test at 1%; - no observation conducted

Table 2. Effect of fertilizer on yield of beluntas

Treatments	Yield per plant (g)	Yield per plot (g)
P0: Control	92.0 b	2813.0 b
P1: Manure	173.5 b	3619.7 b
P2: Urea+SP36+KCl	186.8 a	6949.7 a
P3: P1 +P2	149.3 ab	6775.7 a

Note: The different letters following the values in the same column mean a significant different according to HSD at $P \leq 0.05$.

Treatment of inorganic fertilizer (P2) gave the highest number of yield per plant and yield per plot (Table 2). Combined inorganic and organic fertilizers (P3) also gave the highest yield per plot and it was not significant compared to inorganic fertilizer treatments (P3).

Anova of fertilizer treatments on katuk is presented in Table 3. Treatments of fertilizer did not give significant effect on number of branches, branch length, number of leaves, yield per plant, and yield per plot.

Table 3. Anova of fertilizer treatments on Katuk

Variables	Observation at (WAP)				
	4	5	6	7	7-9
Number of branches	ns	ns	ns	ns	-
Length of branch	ns	ns	ns	ns	-
Number of leaves	ns	ns	ns	ns	-
Yield/plant	-	-	-	-	ns
Yield/plot	-	-	-	-	ns

Note: WAP, weeks after planting; ns: non significant, F test at 5%; - no observation conducted

Anova of fertilizer treatment on kenikir is presented in Table 4. Fertilizer treatments did not affect plant height, number of branches, and number of leaves. The treatments gave significant effect on yield per plot.

Table 4. Anova of fertilizer treatments on Kenikir

Variables	Observation at (WAP)							
	2	3	4	5	6	7	8	7-9
Number of branches	ns	ns	ns	ns	ns	ns	ns	-
Plant Height	ns	ns	ns	ns	ns	ns	ns	-
Number of leaves	ns	ns	ns	ns	ns	ns	ns	-
Yield/plant	-	-	-	-	-	-		*
Yield/plot	-	-	-	-	-	-		ns

Note: WAP, weeks after planting; ns: non significant, F test at 5%;* Significantly difference, F test at 5%;- no observation conducted

Table 5 shows that in kenikir inorganic fertilizer (P2) increased yield per plant and yield per plot. It yielded 909.0 g/plot. Therefore, it was higher than control and manure treatment. The yield was almost four times of the control's yield.

Table 5. Yield per plant and yield per plot of kenikir

Treatments	Yield per plant+ (g)	Yield per plot (g)
P0: Control	32.53	262.7 c
P1: Manure	57.81	457.3 bc
P2: Urea+SP36+KCl	65.28	909.0 a
P3: P1 +P2	58.47	760.3 ab

Note: + is 10 % significant; The different letters following the values in the same column mean a significant different according to HSD at $P \leq 0.05$

Anova of fertilizer treatment on kemangi is presented in Table 6. Table 6 shows that fertilizer treatments affected number of branches (3WAP), secondary branches (6 WAP), plant height (3 and 4 WAP), number of leaves (3, 4, 5, and 6 WAP), yield per plant, and yield per plot.

Table 6. Anova of fertilizer treatments on Kemangi

Variables	Observation (WAP)				
	2	3	4	5	6
Number of primary branches	ns	*	ns	ns	ns
Number of secondary branches	-	-	-	ns	**
Plant height	ns	**	**	ns	ns
Number of leaves	ns	**	**	*	**
Yield/plant	-	-	-	-	**
Yield/plot	-	-	-	-	**

Note : WAP, weeks after planting; ns: non significant, F test at 5%; * Significantly difference, F test at 5%; ** Significantly difference, F test at 1%; - no observation conducted

Inorganic fertilizer (P2) and combination of organic and inorganic fertilizers (P3) gave the highest number of primary branches of kemangi. Moreover, treatment of organic fertilizer (P1), inorganic fertilizer (P2) and combination of organic and inorganic fertilizers (P3) caused higher number of primary branches, secondary branches, and plant height (Table 7).

Table 7. Effect of fertilizer on number of branches and plant height of kemangi

Treatments	Number of primary branches (3 WAP)	Number of secondary branches (6WAP)	Plant Height (cm) (3 WAP)
P0: Control	10.5 b	18.7 b	22.3 b
P1: Manure	12.5 ab	46.8 a	26.3 a
P2: Urea+SP36+KCl	14.3 a	78.3 a	25.3 a

P3: P1 +P2	14.5 a	54.2 a	25.9 a

Note: WAP, weeks after planting; the different letters following the values in the same column mean a significant different according to HSD at $P \leq 0.05$.

Table 8 showed that in kemangi all fertilizer treatments (P1, P2, and P3) increased number of leaves at 6 WAP although the highest number was obtained by P2. Treatment of inorganic fertilizer (P2) yielded 225.8 leaves, while without fertilizer (control) was only yielded 76.0 leaves.

Table 8. Number of kemangi leaves as affected by fertilizer treatments

Variables	Observation at (WAP)			
	3	4	5	6
P0: Control	20.2 b	34.7 b	65.7 b	76.0 b
P1: Manure	29.2 ab	56.0 ab	107.5 ab	154.7 a
P2: Urea+SP36+KCl	30.7 ab	68.5 a	144.7 a	225.8 a
P3: P1 +P2	41.7 ab	81.0 a	135.5 a	199.3 a

Note: WAP, weeks after planting; the different letters following the values in the same column mean a significant different according to HSD at $P \leq 0.05$.

Treatment of combined organic and inorganic fertilizers (P3) caused the highest yield per plant (Table 9). Both P2 (inorganic fertilizer) and P3 (organic +inorganic fertilizer) gave the highest yield per plot.

Table 9. Yield of Kemangi as influenced by fertilizer treatments

Variables	Yield per plant (g)	Yield per plot (g)
P0: Control	7.33 c	96.7 c
P1: Manure	16.08 b	295.7 b
P2: Urea+SP36+KCl	25.17 ab	781.0 a
P3: P1 +P2	30.42 a	742.3 a

Note: The different letters following the values in the same column mean a significant different according to HSD at $P \leq 0.05$.

Inorganic fertilizer treatment (P2) gave better yield compared to other treatments on yield of beluntas, kenikir, and kemangi, although not significantly different with combined organic + inorganic fertilizers (Table 2, 5, 7, and 9). It might that the organic fertilizer used in the experiment contained rice husk in 1:3 ratio, which made N, P, and K contents in this organic fertilizer was low, i.e. 1.5, 1.5, and 0.8 %, respectively. However, the rice husk might improve soil structure (Suriatna, 1988).

Harvested part in beluntas, katuk, kenikir and kemangi is their branch. After harvest, the new branches will emerge. According to Steffek (1969) when a branch is cut, the nearest branch will immediately replace the function of that cut branch. Gardner (1991) also stated that pruning induced the emergence of the new branches by altering the apical dominance effect. In beluntas and kenikir, treatment of NPK fertilizer alone (P2) and its combination with manure (P3) showed the rapid emergence of new branches causing higher yield compared to other treatments.

CONCLUSION

In general, compared to other treatments inorganic fertilizer gave better yield on beluntas, kenikir, and kemangi, although not significantly different with combination of organic + inorganic fertilizers. However, all fertilizer treatments did not affect productivity of katuk.

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REFERENCES

Departemen Pertanian. 2006. Buku Tahunan Hortikultura Seri: Tanaman Sayuran. Departemen Pertanian. Direktorat Jenderal Hortikultura. Direktorat Budidaya Tanaman Sayuran dan Biofarmaka. Jakarta.

FAO. 2005. Fertilizer use by crop in Indonesia. First version.FAO, Rome.

Gardner, F. P., R. B. Pearce and R. L. Mitchell. 1991. Physiology of Crop Plants.

Kastono, D., H. Sawitri, dan Siswandono. 2005. Pengaruh Nomor Ruas Setek Dan Dosis Pupuk Urea terhadap Pertumbuhan dan Hasil Kumis Kucing. Ilmu Pertanian 12:56-64.

Kusmana dan Suryadi. 2004. Mengenal Sayuran Indijenes, Balai Penelitian Tanaman Sayuran. Bandung.

Leiwakabessy, F. M. dan A. Sutandi. 2004. Pupuk dan Pemupukan. Departemen Tanah. Fakultas Pertanian. Institut Pertanian Bogor. Bogor.

Sarief, S. 1986. Kesuburan dan Pemupukan Tanah Pertanian. Pustaka Buana, Bandung.

Soepardi, G. 1983. Sifat dan Ciri Tanah. Jurusan Tanah. Fakultas Pertanian. Institut Pertanian Bogor. Bogor.

Steffek, E F. 1969. The Pruning Manual. Van Norstrand Reinhold Company. New York.

Subhan, N. Nurtika, W. Setiawati. 2008. Peningkatan Efisiensi Pemupukan NPK dengan Memanfaatkan Bahan Organik terhadap Hasil Tomat http://www.balitsa.org. [3 Agustus 2008].

Suriatna, S. 1988. Pupuk dan Pemupukan. Mediyatama Sarana Perkasa, Jakarta.

Tisdale, S. L., W. L. Nelson, and J. D. Beaton. 1985. Soil Fertility and Fertilizer. 4th Ed.. Macmillan Publish. Co. Inc. New York.