Original Research Article

Residual effect of Sago Dregs Fertilizer to Okra (*Abelmoschus esculentus*) Growth and Yield in Planting Period II in Marginal Land

ABSTRACT

Aims: The research aimed to study the potential of sago dregs fertilizer residue in increasing the growth and yield of okra (*Abelmoschus esculentus*) in planting period II on marginal land.
Study design: Singel factor design in Randomized block design
Place and Duration of Study: The research was conducted in Field Laboratory of Faculty of Agriculture, University of Halu Oleo, Kendari, Southeast Sulawesi, Indonesia. The study was conducted for four months.
Methodology: Single factor design in Randomized block design was used in the research. consists of 6 treatment levels of sago dregs fertilizer residue that have been applied in the previous planting period (planting period I), namely: without sago dregs (S0), using sago dregs 5 t ha-1 (S1), 10 t ha-1 (S2), 15 t ha-1 (S3), 20 t ha-1 (S4) and 25 t ha-1 (S5). Each treatment was placed in three groups so that there were 18 experimental units. The data was analyzed using analysis of variance and continued by Tukey Test 95% confidence level.
Results: The results generally showed that the sago dregs fertilizer residual had a significant effect on the growth and yield of *Abelmoschus esculentus*.
Conclusion: Residual of sago dregs fertilizer potentially increasing of okra (*Abelmoschus esculentus*) growth and yield in planting period II in marginal land.

Keywords: [Marginal land; okra; residual effect; sago dregs fertilizer }

1. INTRODUCTION

Okra (*Abelmoschus esculentus* L.). Okra is a type of vegetable plant known by the Latin binomial name Abelmoschus esculentus and Hibiscus esculentus [1], known in the Middle East as bamia, bamya or bamieh [2]. In Southeast Sulawesi it is known as *kopi gandu*.

Okra contains protein, carbohydrates and vitamin C [3]. Suggested the chemical composition of okra leaves per 100 g contains 82.60% water content, protein 4.81%, fiber 1.13%, oil 0.19%, ash 2.44%, carbohydrates 8.83%; young fruit per 100 g contains 88.47% water content, 2.56% protein, fiber 0.37%, oil 0.18%, ash 1.38%, carbohydrates 7.05%; ripe fruit per 100 g contains moisture content 82.25%, 2.51% protein, 2.44% fiber, 0.46% oil, ash 1.17%, carbohydrates 11.16% [4]. Okra has many benefits for you health, can reduce the risk of a number of diseases chronic diseases, such as atherosclerosis and cancer [5]. Common parts of the okra plant consumed is the fruit. Young okra fruit can consumed fresh or consumed in other forms (Ndunguru and Rajabu 2004). can be steamed, fried or cooked [6], processed with a mixture of other vegetables.

Efforts to increase okra production are necessary keep doing. Currently development of okra plants especially in Southeast Sulawesi has not been done seriously. From a land availability perspective, Southeast Sulawesi has enough potential great for okra development, however levels low soil fertility is oneproblems that must be addressed immediately. Sulawesi The Southeast is recorded as having the potential for dry land quite extensive, amounting to 3,814,000 ha, 69% of the total area is dry land [7]. Low and unsuitable soil fertility can make plants do not grow optimally.

An alternative that can be chosen in overcoming the problem of low soil fertility is the use of organic fertilizers. It's plays a very important role in increasing plant productivity. Organic matter, such as sago dregs, cow dung, crop residue and poultry manure are cheap and easily available sources of nutrients for smallholder farmers, and also they are environmentally friendly [8,9]. In addition to having a relatively complete nutrient, also have an effect in the time period long enough. The use of organic fertilizers is one means of increasing sustainable crop production [8,10] and reduces the use of inorganic fertilizers to improve plant growth [10]. Generally, organic fertilizers are made from agricultural waste like sago dregs, and cattle dung. Reported [11], sago dregs contained a high amount of Nitrogen (13.55%), Phosphorus (29.55 mg/100 g), potassium (5.10 mg/100 g), calcium (10.97 cmol (+)/kg) and magnesium (1.97 cmol (+)/kg).

The residual effect of organic fertilizer aplication using matter such as sago dregs and cow dung can improve the quality of soil properties. Application of bioslurry and composted poultry manure as a bio-fertilizer improves soil organic matter contents and availability of soil nutrients (N, P and K) to the subsequent crop, which in-turn increases crop productivity and reduces the cost of fertilizer to subsequent crop [12]. The slow decomposing residues have a steady impact on soil structure and provide a long-term impact on increasing levels of soil organic matter [13]. Among organic wastes, municipal solid waste and filter cake integrated with full NPK mineral fertilizers were outstanding in terms of residual effect enhancing wheat productivity under irrigated conditions. Moreover, these treatments also have retained higher soil total organic carbon and total mineral N after 2 years long experiment that enhanced the wheat yield [14]. Reported [15] that for the second planting, residual of 5000 kg/ha cow manure was able to increase the number of pods per plant, number of seeds per pot, seed weight per pot up to 63.7%, 69%, 43.2% respectively. The residual effect of organic fertilizer is confirmed, improving the chemical properties of soil and production of radish in the "high" soil fertility area [16].

The previous description shows the importance to utilization of residual effect organic fertilizers in several planting periods. In this research stated the residual effect of sago dregs fertilizer to growth and yield of Okra (*Abelmoschus esculentus* L.) in planting period II in marginal land.

2. MATERIAL AND METHODS

2.1 Experimental Site

The research was conducted in Field Laboratory of the Faculty of Agriculture, University of Halu Oleo, Kendari, Southeast Sulawesi, Indonesia. The study was conducted for four months.

2.2 Experimental design

Single factor design in Randomized block design was used in the research. consists of 6 treatment levels of sago dregs fertilizer residue that have been applied in the previous planting period (planting period I), namely: without sago dregs fertilizer (S0), using sago dregs fertilizer 5 t ha-1 (S1), 10 t ha-1 (S2), 15 t ha-1 (S3), 20 t ha-1 (S4) and 25 t ha-1 (S5). Each treatment was placed in three groups so that there were 18 experimental units. The data was analyzed using analysis of variance and continued by Tukey Test 95% confidence level.

2.3 Procedure

This research begins with seed preparation and land. The seed was using lokal variety, taken from Kendari, Souteast Sulawesi, Indonesia. Land processing for the second planting period was carried out immediately after harvesting the okra for the first planting period. Before cultivating the land in the second planting period, the land was cleared of the remaining weeds by clearing it using a machete. Then loosening the soil in each plot using a hoe, without changing the shape and position of the experimental plots during the first planting period. The experimental plots were 4 m x 3 m, each bordered with a trench with a width of 50 cm. Planting seeds with a spacing of 20 cm x 30 cm, one seed per planting hole.

Fertilization was applied in planting period I, by spreading, with different doses in each experimental plot, adjusted according to treatment. In this planting period II, studied the residual effect of sago dregs fertilizer that applicated at the planting period I.

The parameters observed included: (1) plant height, measured from the base of the stem to the highest leaf after straightening; (2) diameter of the stem was measured at the middle of the corn plant using a caliper; (3) number of leaves (strands), was calculated based on the number of leaves formed; (4) Leaf area was done by measuring leaf length, leaf width, leaf area, calculated by the formula: leaf length x leaf width x constant x number of leaves; (5) plant dry weight before flowering; (6) number of fruit (until the seventh harvest); (7) weight of fruit (until the seventh harvest). The data was analyzed using analysis of variance and continued by by Tukey Test 95% confidence level.

3. RESULTS AND DISCUSSION

3.1 Vegetatif growth of plant

Organic fertilizers have an excellent effect on improving the physical, chemical and biological qualities of the soil, which in turn increases plant growth and yield. The resulting residual effect have a beneficial effect on subsequent plantings, over several growing periods. Various types of organic fertilizers made from agricultural waste and livestock feces have

been proven by several researchers in an effort to increase crop yields. Residual effects of organic fertilizers can last relatively longer, in several planting periods. It was reported [17] that cow manure applied to the planting medium in the first planting period gave a very good residue effect in the second planting period, which could increase the growth and yield of corn plants. This is in accordance with the findings of [18], that the residual effect of organic fertilizers, especially manure, has a considerable effect on the second season of cowpea plants. The dry weight of roots and shoots of cowpea plants is strongly influenced by the influence of cow dung residue [19]. The residual effect of sheep manure applied to chili plants in the previous season can maintain the growth and productivity of subsequent cowpea plants without the need for further application in the growing season. This will increase the sustainability of the cropping system and help maintain soil fertility [20].

The results obtained in this study indicate that sago dregs organic fertilizer applied to the planting medium in the first planting season also gives results that are in line with the reports of several previous researchers, that the residual effect of sago dregs organic fertilizer can increase plant growth in the second planting period. (Table 1). The effectiveness of the residual effect of sago pulp organic fertilizer is 3.39% to 25.68% on the variable plant height, 12.77% to 24.07% on the variable stem diameter, 17.72% to 32.26% on the variable number of leaves, 23.84% to 53.03% on the variable area leaves, and 24.06% to 39.15% in plant dry weight variable, strongly influenced by the dose of sago pulp organic fertilizer applied in growing season I. The effectiveness highest of residual effect was achieved in the treatment of 15 t ha^{-1} sago dregs organic fertilizer, for all of variables observed vegetative growth (Table 2).

3.2 Yield of plant

The increase in plant growth is a residual effect of sago dregs fertilizer which supports photosynthesis so that plant growth increases. The increased supply of nitrogen and its higher uptake by plants may have stimulated the rate of various physiological processes in plants and led to increased growth and yield [21]. The results showed that the yield of okra plants in the second planting period with the application of sago dregs fertilizer in the planting medium applied during the first planting period was better than without sago dregs, the effectiveness of the residual effect of sago dregs organic fertilizer is 20.21% to 41.61% on the variable number of fruit and 14.46% to 34.21% on the variable weight of fruit (Table 3). This result is in accordance with the findings of [22,23,24,25]. It was also reported [17], that organic fertilizers given in the first planting period had a residual effect on the planting medium, increasing plant growth and productivity. Another factor is the increased uptake of Phosphorus by plants and the availability of Phosphorus in the growing medium. The residual effect of organic fertilizers was confirmed, improving soil chemical properties and crop production in nutrient-poor soils. Phosphorus contributes to the complex structure of plant nucleic acids. Nucleic acids are very important in the regulation of protein synthesis; therefore, P is important in cell division and the development of new plant tissues. P is one of the 17 essential nutrients for plant growth and is related to complex energy transformations in plants [26]. Phosphorus in plants as a structural component of nucleic acids, sugars and lipids. P plays a role in the process of plant development both at the cellular level and as a whole plant. Under conditions of P deficiency, plants undergo various morphological, physiological and biochemical adaptations [27].

Table 1. The residual effect of sago dregs fertilizer on the vegetative growth of okra plant during planting period II on marginal land

Sago dregs fertilizer (t ha^{-1})	Plant height 35 dap (cm)	Stem diameter 35 dap (cm)	Number of leaves 35 dap (strand)	Leaf area 35 dap (cm^2)	Dry weight of plant (g)
0	7.12 a	0.41 a	4.83 a	80.94 a	26.07 a
5	7.69 a	0.47 b	5.87 b	106.28 b	34.33 b
10	8.64 b	0.51 b	6.67 c	151.58 d	38.48 b
15	9.58 c	0.54 c	7.13 c	172.33 e	42.84 c
20	7.37 a	0.48 b	6.27 b	124.23 c	36.68 b
25	7.71 a	0.47 b	6.17 b	114.16 a	33.76 b

Note: Different letters indicate significantly different according Tukey Test 95% confidence level.

Table 2. The effectiveness (Ef) treatment residual effect of sago dregs fertilizer on the vegetative growth of okra plant during planting period II on marginal land

Sago dregs fertilizer (t ha^{-1})	Plant height 35 dap (cm)	Ef (%)	Stem diameter 35 dap (cm)	Ef (%)	Number of leaves 35 dap (strand)	Ef (%)	Leaf area 35 dap (cm^2)	Ef (%)	Dry weight of plant (g)	Ef (%)
0	7.12		0.41		4.83		80.94		26.07	
5	7.69	7.41	0.47	12.77	5.87	17.72	106.28	23.84	34.33	24.06
10	8.64	17.59	0.51	19.61	6.67	27.59	151.58	46.60	38.48	32.25
15	9.58	25.68	0.54	24.07	7.13	32.26	172.33	53.03	42.84	39.15
20	7.37	3.39	0.48	14.58	6.27	22.97	124.23	34.85	36.68	28.93
25	7.71	7.65	0.47	12.77	6.17	21.72	114.16	29.10	33.76	22.78

Note: Different letters indicate significantly different according Tukey Test 95% confidence level. Effectiveness (Ef) treatment residual effect of sago dregs fertilizer was calculated using formula: Ef (%) = (Treatment – control) / Treatment x 100.

Table 3. The residual effect of sago dregs fertilizer on the yield of okra plant during planting period II on marginal land

Sago dregs fertilizer (t ha^{-1})	Number of fruit per plot	Ef (%)	Weight of fruit (g) per plot	Ef (%)
0	23.69 a		45.43 a	
5	31.57 b	24.96	53.87 b	15.67
10	34.53 b	31.39	61.55 c	26.19
15	40.57 c	41.61	69.05 d	34.21
20	30.17 b	21.48	54.79 b	17.08
25	29.69 b	20.21	53.11 b	14.46

Note: Different letters indicate significantly different according Tukey Test 95% confidence level. Effectiveness (Ef) treatment residual effect of sago dregs fertilizer was calculated using formula: Ef (%) = (Treatment – control) / Treatment x 100.

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