



Residual Effect of Cow Dung Fertilizer to Corn (*Zea mays* L.) Growth and Yield in Planting Period II in Marginal Land

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Authors' contributions

This work was carried out in collaboration among all authors. Author RH designed the study, wrote the draft of the manuscript and managed the analyses of the study. Author AB designed and managed the analyses of the study. Author MJA designed the study, performed the statistical analysis. All authors read and approved the final manuscript.

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ABSTRACT

Aims: The research aimed to study the potential of cow dung fertilizer residue in increasing the growth and yield of corn plant in planting period II on marginal dry land.

Study Design: Singel factor design in Randomized block design.

Place and Duration of Study: The research was conducted in Field Laboratory of the Faculty of Animal Husbandry, 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 cow manure residue that have been applied in the previous planting period (planting period I), namely: without cow manure (R0), using cow manure 2.5 t ha⁻¹ (R1), 5 t ha⁻¹ (R2), 7.5 t ha⁻¹ (R3), 10 t ha⁻¹ (R4) and 12.5 t ha⁻¹ (R5). 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 Duncan's Multiple Range Test (DMRT) 95% confidence level.

Results: The results showed that the vegetative growth of corn plant 30 day after planting (dap) and plant yield was affected by residual effect of cow dung that applicated in the planting periode I, thus with P uptake by plant and available P in planting medium.

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Conclusion: Plant productivity during planting period II more increased with the higher dose of cow manure applied during planting period I. The highest plant productivity (3.88 t ha^{-1}) in planting period II was obtained by application of cow dung 12.5 t ha^{-1} during planting period I. While in the planting medium without cow dung, no seeds formation was found in plants.

Keywords: Marginal land; organic fertilizer; residual effect.

1. INTRODUCTION

Corn (*Zea mays* L.) is an important food ingredient in Indonesia, the second source of carbohydrates after rice. Given the importance of corn's position as a staple food ingredient, it is necessary to increase the productivity of corn plant.

The use of organic fertilizers plays a very important role in increasing plant productivity. Organic matter, such as cow dung, crop residue and poultry manure are cheap and easily available sources of nutrients for smallholder farmers compared to expensive inorganic fertilizer and also they are environmentally friendly [1,2]. 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 [1,3] and reduces the use of inorganic fertilizers to improve plant growth [3]. For acid soil, application of organic cow manures can replace inorganic fertilizer, but the amount of organic cow manure applied should be around 5000 kg ha^{-1} [4]. Application of organic fertilizers could increase growth parameters, essence yield and nutrients uptake in summer savory compared with control treatment [5]. The yields of sweet corn plants from plots applied with organic and inorganic fertilizers are significantly higher than the yields from sole inorganic fertilizer application. Farmers can use less amount of inorganic fertilizers, complemented with organic manures to cultivate sweet corn, however, higher yields will still be obtained than only sole inorganic fertilizer application [6]. Generally, organic fertilizers are made from agricultural waste and cattle dung. Chemical characteristics of the cattle dung were pH 7.86, N 28.7 g kg^{-1} , C/N 10.7, NH_4^+ 0.02 g kg^{-1} , NO_3^- 0.7 g kg^{-1} [7]. Cow dung contains a high amount of nutrients essential for plants. Cow dung has higher pH (6.21), C/N ratio is less than 10, which means that the nutrients contained in cow dung can be quickly utilized by crops [8]. The results of the analysis of the nutrient content of cow dung consist of C organic 16.49%, N total

1.65%, P 0.84%, K 0.79%, Na 0.32%, Ca 1.79%, C/N 10, KTK $95.83 \text{ me } 100 \text{ g}^{-1}$ and organic material 28.54% [9]. Cow dung application have been found to be increased the total N, available P, exchangeable K, Ca, Mg, available S, Zn and B contents in soils and biomass yield of plant [10].

The residual effect of organic matter such as 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 [11]. The slow decomposing residues have a steady impact on soil structure and provide a long-term impact on increasing levels of soil organic matter [12]. 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 [13].

The preceding description shows the importance of exploiting the residual effect of organic fertilizers in several planting periods. In this research, the residual effect of cow dung fertilizer to corn (*Zea mays* L.) growth and yield in planting period II in marginal land was studied.

2. MATERIALS AND METHODS

2.1 Experimental Site

The research was conducted in Field Laboratory of the Faculty of Animal Husbandry, 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 cow manure residue that have been

applied in the previous planting period (planting period I), namely: without cow manure (R0), using cow manure 2.5 t ha⁻¹ (R1), 5 t ha⁻¹ (R2), 7.5 t ha⁻¹ (R3), 10 t ha⁻¹ (R4) and 12.5 t ha⁻¹ (R5). 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 Duncan's Multiple Range Test (DMRT) 95% confidence level.

2.3 Procedure

This research begins with seed preparation and land. The seed was using lokal variety, taken from Ereke, North Buton, Souteast Sulawesi, Indonesia. Land processing for the second planting period was carried out immediately after harvesting the corn 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 and a trench between the treatment plots which was 30 cm.

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 cow dung fertilizer that applied 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) cob dry weight; (6) weight of 100 grains per sample; (7) dry seed production; (8) soil available Phosphor content; (9) Phosphor uptake of plants. The data was analyzed using analysis of variance and continued by Duncan's Multiple Range Test (DMRT) 95% confidence level.

3. RESULTS AND DISCUSSION

3.1 Vegetatif Growth

The vegetative growth of corn plant 30 day after planting (dap) was affected by residual effect of

cow dung that applied in the planting periode I. The result showed that vegetative growth of corn plant during planting period II on marginal land with cow dung applied in various doses were better than without cow dung (Table 1). These results are in accordance with findings of [14], that the residual effect of organic manure especially farm yard manure has considerable influence on second season cowpea crop. The dry weight of roots and shoots of cowpeas plant was significantly affected by residual effect of cow manure [15]. Residual effect of sheep manure applied to chilli pepper in the previous season can sustain the growth and productivity of succeeding cowpea crop without the need for further application in the cropping season. This will improve the sustainability of the cropping system and help maintain soil fertility [16]. This result was caused by residual effect of cow dung increase the photosynthesis so that the plant growth. The increased supply of nitrogen and its higher uptake by plant might have stimulated the rate of various physiological processes in plant and led to increase growth and yield [17].

3.2 Yield, Phosphor Uptake and Availabel Phosphor

Plant yield was affected by residual effect of cow dung that applied in the planting periode I, thus with P uptake by plant and available P in planting medium. The result showed that plant yield of corn plant during planting period II on marginal land by cow dung various doses was applied in planting period I were better than without cow dung (Table 2 and Table 3). These results indicated that the organic fertilizer applied in the first planting period has a residual effect on the growing medium which is shown by its effect on plant growth, yield, Phosphor uptake and availabel Phosphor. These results are in accordance with findings of [18-21]. The residual effect of organic fertilizer is confirmed, improving the chemical properties of soil and production of corn plant in the soil nutrient poor. One of role cow dung fertilizer was to increase the growth of plant so that the yield components and productivity of plant could increase. The other factor was increase of Phosphorus uptake by plant and phosphorus availability in planting medium. Phosphorous contributes in the complex of the nucleic acid structure of plants. The nucleic acid is essential in protein synthesis regulation; therefore, P is important in cell division and development of new plant tissue. P is one of the 17 essential nutrients for plant growth and related to complex energy

Table 1. The residual effect of cow dung fertilizer on the vegetative growth of corn plant during planting period II on marginal land

Cow dung (t ha ⁻¹)	Plant height (cm)	stem diameter (cm)	Number of leaves (strand)	Leaf area (cm ²)
0.0	10.90 ^b	0.70 ^b	7.00 ^b	477.91 ^d
2.5	25.50 ^a	1.10 ^{ab}	8.70 ^{ab}	1515.01 ^c
5.0	31.80 ^a	1.20 ^a	9.00 ^a	1787.57 ^{bc}
7.5	28.40 ^a	1.29 ^a	9.00 ^a	1822.38 ^{bc}
10.0	31.60 ^a	1.40 ^a	9.70 ^a	2630.41 ^{ab}
12.5	34.80 ^a	1.43 ^a	9.67 ^a	2868.45 ^a

Note: Different letters indicate significantly different according Duncan's Multiple Range Test (DMRT) 95% confidence level

Table 2. The residual effect of cow dung fertilizer on the yield of corn plant during planting period II on marginal land

Cow dung (t ha ⁻¹)	Cob dry weight (g)	Weights 100 seeds (g)	Plant productivity (t ha ⁻¹)
0.0	0.00 ^d	0.00 ^c	0.00 ^e
2.5	32.70 ^{cd}	20.50 ^b	1.70 ^d
5.0	64.60 ^{bc}	24.20 ^a	2.30 ^c
7.5	120.88 ^a	24.01 ^a	3.10 ^b
10.0	102.60 ^{ab}	24.20 ^a	3.60 ^{ab}
12.5	118.89 ^a	27.30 ^a	3.88 ^a

Note: Different letters indicate significantly different according Duncan's Multiple Range Test (DMRT) 95% confidence level

Table 3. The residual effect of cow dung fertilizer on Available Phosphor in growing media and Phosphor uptake of corn plant during planting period II on marginal land

Cow dung (t ha ⁻¹)	Available Phosphorus (ppm)	Phosphorus uptake (mg per plant)
0.0	1.40 ^c	3.60 ^d
2.5	4.00 ^b	6.50 ^{cd}
5.0	5.70 ^a	5.30 ^{cd}
7.5	5.95 ^a	8.75 ^{bc}
10.0	6.20 ^a	12.40 ^a
12.5	6.46 ^a	12.00 ^a

Note: Different letters indicate significantly different according Duncan's Multiple Range Test (DMRT) 95% confidence level

transformations in the plant [22]. Phosphorus in plants as a structural component of nucleic acids, sugars and lipids. P plays a role in plant's developmental processes at both cellular and whole plant level. Under P-deficient condition, plants undergo various morphological, physiological and biochemical adaptations [23].

4. CONCLUSION

Residual of cow dung fertilizer potentially increasing of corn plant growth and yield in planting period II in marginal land. Plant productivity during planting period II more increased with the higher dose of cow manure applied during planting period I. The highest plant productivity (3.88 t ha⁻¹) in planting period II was obtained by application of cow dung 12.5 t

ha⁻¹ during planting period I. While in the planting medium without cow dung, no seeds formation was found in plants.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

- Hasid R, Arma MJ, Nurmas A, Sadar. Pertumbuhan dan hasil Tanaman Jagung

- (*Zea mays* L.) di Lahan Kering Marginal dengan aplikasi Mikoriza Arbuskula dan Pupuk Kotoran sapi. J. Berkala Penelitian Agronomi. 2020;8(1):63-73. Indonesia.
2. Gezahegn AM, Martini MY. Effects of Residual Organic Manure and Supplemental Inorganic Fertilizers on Performance of Subsequent Maize Crop and Soil Chemical Properties. Int. J. Res. Studies Agric. Sci. 2020;6(1):1-9.
 3. Pujiasmanto B, Sunu P, Toeranto, Imron A. The influence of kind and dose of manure in relation to creat growth and yield (*Andrographis paniculata* Ness.). J. Soil Sci. Agroclimat. 2009;6:81-90.
 4. Kuntiyastuty H, Muzaiyanah S. Effect of organic fertilizer and its residual on cowpea and soybean in acid soils. J. Degrade. Min. Land Manage. 2017;5(1):987-994.
DOI: 10.15243/jdmlm.2017.051.987
 5. Esmailpour B, Rahmanian M, Khorramdel S, Gharavi H. Effect of Organic Fertilizers on Nutrients Content and Essential Oil Composition of Savory (*Satureja hortensis* L.). Agritech. 2018;38(4):433-441.
 6. Sofyan ET, Sara DS. The Effect of Organic and Inorganic Fertilizer Applications on N, P and K Uptake and Yield of Sweet Corn (*Zea mays saccharata* Sturt). J. Trop Soils. 2018;23(3):111-116.
 7. Huang J, Yu Z, Gao H, Yan X, Chang J et al. Chemical structures and characteristics of animal manures and composts during composting and assessment of maturity indices. PLoS ONE. 2017;12.
Available: 10.1371/journal.pone.0178110.
 8. Kuntiyastuti H, Lestari SAD, Sutrisno S. Effects of organic fertilizer and plant spacing on early medium maturity soybean. J. Degrade. Min. Land Manage. 2018;5:1171-1179.
 9. Hasid R., Arma MJ, Nurmas A, Halim, Arsana MW. Effect of indigenous arbuscular mycorrhizal formulations with cow dung to phosphorus uptake, growth and yield of local corn (*Zea mays* L.) in Marginal land. Asian J. Plant Sci. 2021; 20(2):196-202.
 10. Zaman MM, Chowdhury T, Nahar K, Chowdhury MAH. Effect of cow dung as organic manure on the growth, leaf biomass yield of *Stevia rebaudiana* and post harvest soil fertility. J. Bangladesh Agric. Univ. 2017;15:206-211.
 11. Shahzad K, Khan A, Smith JoU, Saeed M, Khan SA, Khan SM. Residual effects of different tillage systems, bioslurry and poultry manure on soil properties and subsequent wheat productivity under humid subtropical conditions of Pakistan. Int. J. Biosci. 2015;6(11):99-108.
 12. Cattaneo F, Barbanti L, Gioacchini P, Ciavatta C, Marzadori C. 13C abundance shows effective soil carbon sequestration in miscanthus and giant reed compared to arable crops under Mediterranean climate. Biology and Fertility of Soils. 2014;50(7):1121-1128.
 13. Shehzadi S, Shah Z, Mohammad W. Residual effect of organic wastes and chemical fertilizers on wheat yield under wheat-maize cropping sequence. Soil and Environ. 2014;33(2):88-95.
 14. Yasodha M, Chinnusamy C. Direct and residual effect of organic manures and inorganic fertilizer application in brinjal + onion - cowpea - sunnhemp cropping system. J. Pharmacognosy and Phytochemistry. 2019;8(3):2335-2339.
 15. Lestari SAD, Sutrisno, Wijanarko A, Kuntiyastuti H. Efek Residu Kacang Hijau Pertanaman Pertama pada Pertumbuhan dan Hasil Kacang Tunggak Pertanaman Kedua di Lahan Kering. J. Ilmu Pertanian Indonesia (JIPI). 2020; 25 (4):644-652. Indonesia.
 16. Babaji BA, Yahaya RA, Mahadi MA, Jaliya MM, Ajeigbe HA, Sharifai AI, et al. Response of cowpea [*Vigna unguiculata* (L.) Walp] to residual effect of different application rates of sheep manure on chilli pepper (*Capsicum annuum*). J. of Food, Agric. & Environ. 2010;8(2):339-343.
 17. Mandal UK, Singh G, Victor US, Sharam KL. Green manuring: its effect on soil roperties and crop growth under rice-wheat cropping system. Eur. J Agron. 2003;19(2):225-237.
 18. Mogle UP, Naikwade PV, Patil SD. Residual effect of organic manure on growth and yield of *Vigna unguiculata* (l) Walp and *Lablab purpureus* L. Sci. Res. Reporter. 2013;3(2):135-141.
 19. Ram M, Davari MR, Sharma SN. Direct, residual and cumulative effects of organic manures and biofertilizers on yields, NPK uptake, grain quality and economics of wheat (*Triticum aestivum* L.) under organic farming of rice-wheat cropping system. J. Organic Systems. 2014;9(1):16-30.
 20. Lanna NBL, Silva PNL, Colombari LF, Corrêa CV, Cardoso All. Residual effect of

- organic fertilization on radish production. Hort. bras. 2018;36(1):47-53.
21. Afrida E, Rauf A, Hanum H, Harnowo D. Residual Effect Of Organic Fertilizer And Addition Inorganik Fertilizer To Nutrient Uptake, Growth And Productions Of Black Soy Bean (*Glycine Max* L. Merr) At Rainfed Areas. Internas. J. Scient. & Tech. Res. 2015;4(02):182-190.
22. Sharma LK, Zaeen AA, Bali SK, Dwyer JD. Improving Nitrogen and Phosphorus Efficiency for Optimal Plant Growth and Yield. New Visions in Plant Science. IntechOpen; 2017. Available:<http://dx.doi.org/10.5772/intechopen.7221>.
23. Malhotra H, Vandana, Sharma S, Pandey R. Phosphorus Nutrition: Plant Growth in Response to Deficiency and Excess. In: M. Hasanuzzaman et al. (eds.). Plant Nutrients and Abiotic Stress Tolerance; 2018. Available: https://doi.org/10.1007/978-981-10-9044-8_7

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