Research Article
Open Access

Effect of weed biomass on cassava yield related to weeding times

Abstract

It is well known that poor weeding is cause of difficulty of weed growth reduction and reduce root yield of cassava. This study conducted to confirm quantitatively relationship of weed biomass and cassava root yield under difference weeding frequency. Field experiment was carried out in Agricultural Research Center, National Agriculture and Forestry Research Institute, Lao PDR from May 2014 to March 2015. The experiment was laid out in RCBD with four replications. The treatments consisted of four types of manual weed control; no weeding, 1 time weeding at 2 MAP, 2 times weeding at 1.5 and 3 MAP, and 3 times weeding at 1, 2, 3 MAP. The plot size was 36m2 and plant density was 10, 000 stands ha-1. Chemical fertilizer was applied 100-50-50kg N-P2O5-K2O ha-1. Soil property was estimated before experimental establishment. Fresh weight of weed of above ground was measured at 6 MAP to determine DM. Cassava root yield was measured fresh weight at 10MAP. Weed biomass was significant decrease by increasing the weeding time ($p \leq 0.05$). The no weeding treatment was covered by a lot of weed. The 1 time weeding reduced uncertainly weed growth. More than 2 times weeding restricted weeds growth. Cassava root yield was significantly increased by increasing the weeding time ($p \leq 0.05$). Cassava root yield was high in the 2 times and 3 times weeding. The 1 time weeding varied widely cassava root yield. With the no weeding, cassava root yield was 15% compared with 3 times weeding. Relationship between the weed biomass and the cassava root yield was highly contributed (R2=0.811). Extension of weeding to farmers should be based on weed biomass not the time of weeding for labor saving on cassava cultivation.

Keywords: weed biomass, cassava yield, weeding, weeding time, relationship of weed, cassava

Volume 5 Issue 5 - 2016

Phanthasin Khanthavong,[1] Saythong Oudthachit,[1] Amphay Souvannalat,[1] Naruo Matsumoto[2]

[1]National Agriculture and Forestry Research Institute, Loas
[2]Japan International Research Center for Agricultural Sciences, Japan

Correspondence: Phanthasin Khanthavong, Nongviengkham village, Xaythany district,Vientine, Lao P.D.R.Tel: 021 770094, Fax 021 770047, Email khanthavongp@gmail.com

Received: May 08, 2016 | **Published:** December 28, 2016

Abbreviations: MAP, months after planting; Ha, hectare; M, meter; Mm, millimeter; Kg, kilogram; T, tone; DM, dry mater; RCBD, randomized complete block design. °: Celsius °C, degree celsius

Introduction

Cassava (*Manihot esculenta* Crantz) is a new important cash crop in Laos. Cassava cultivation area increased since 2011 along with increase of tapioca starch factories. Based on our survey in 2013-2015, cassava root yield in farmer fields were varied 12-56 t ha^{-1}. Some fields were covered by a lot of weeds. Cassava is cultivated by small holder farmers who do not have enough information on cultivation practices.

It is well known that poor weeding reduces root yield.[1] Reviewed effect of weed control on cassava root yield that full time of weed infestation causes root yield loss of about 46-95%.[2,3] Also reported weedy condition reduced cassava root yield as about 25% and 8% of weed controlled condition. However, study on relationship between cassava root yield and weed biomass is not enough.[4] conducted a field experiment to clarify change of cassava root yield by weeding frequency in Sierra Leone in 1972/73 and 1973/74. The relationship of cassava root yield and weed biomass was liner as $Y = -1.23W + 12.8$ ($r = -0.95$), where Y is cassava root yield (t ha^{-1}), W is weed dry biomass (t ha^{-1}). Once of weeding did not reduce weed biomass and reduce cassava root yield as 4 t ha^{-1}. The weed biomass reduced limited by three times of weeding and sufficiently by four times of it. We think that confirmation of this relationship in Asian country using improved variety is needed.

Farmers of Lao PDR mostly conduct weeding with one time in cassava cultivation. It likely is cause of difficulty of weed growth reduction. We thought extension for farmers to reduce weed should be based on amount of weed not weeding time. In Lao PDR, cassava cultivation area will increase furthermore. It is expected load of weeding will be constraint of cassava production increasing. For efficient weeding work, clarification of weed frequency, weed biomass, and cassava root yield is important. This study conducted to confirm of relationship of weed biomass and cassava root yield under different weeding frequency in a research center in Lao PDR using a Thai improved variety KU-50.

Material and methods

This experiment was conducted in Agricultural Research Center (18° 08.7'N, 102° 44.3'E), National Agriculture and Forestry Research Institute, Vientiane, Lao PDR from May 2014 to March 2015. At Vientiane Capital, annual mean temperature was 27.8°C, and average of annual precipitation was 1454mm.[5] The experiment plots were designed as RCBD with four replications. The plot size was 6mx6m. The treatments consisted of four types of weed control including of no weeding, 1time weeding at 2months after planting (MAP), 2 times weeding at 1.5 and 3 MAP, and 3 times weeding at 1, 2, 3 MAP.

The experimental field was ploughed and harrowed on 2 and 6 May 2014. Cassava variety was KU-50. The stem cut as 20cm length was planted on 7 May 2014 in vertically position with 1 m x 1 m intervals giving a plant population of 10,000 stands ha^{-1}. Chemical

fertilizer was applied 50-50-50kg N-P_2O_5-K_2O ha^{-1} as urea, TSP, KCl by side dressing at 20 cm distance from planted stem and covered by soil at the planting time. Additionally, 50 kg N ha^{-1} as urea was applied with side dressing at 20 cm distance from stand and covered by soil on 5 July 2014.

Fresh weight of weed of aboveground in 3mx3m at center in each plot was measured on 3 December 2014. To determine DM ratio of the weeds in each plot, a part of weeds of each plot was collected, was measured fresh weight, was dried in oven with 70°C for 48hours, and was measured the dry weight after drying. To determine root yield, cassava root in the area of 4mx4m at center of each plot was collected and was measured fresh weight on 6 March 2015. Soil chemical properties of the experimental field before establishment was pH (H₂O, 1:2.5) 4.6, Total C 9.0g kg^{-1}, Total N 0.87g kg^{-1}, available P (Bray-2) 30mg P kg^{-1}, exchangeable K 0.19cmolc kg^{-1}, exchangeable Mg 0.21cmolc kg^{-1} and exchangeable Ca 0.9cmolc kg^{-1}. Statistical analysis was conducted using JMP ver.10 (SAS Institute, 2012).

Results and discussion

Results

Weed biomass was significantly decreased by increasing the weeding time (Table 1). The plots of the no weeding treatment were covered by a lot of weeds. Weed biomass in the 1 time weeding was varied widely 2.0-5.6t ha^{-1}. Effect of the 1 time weeding to reduce weed growth is uncertain. More than 2 times weeding restricted weeds growth. Cassava root yield was very small in the no weeding treatment and high in the 2 times and 3 times weeding (Table 1). In the 1 time weeding, cassava root yield was varied 11-26t ha^{-1}. In the no weeding, cassava root yield was very poor as 4 t ha^{-1} which was 15% compared with it in the 3 times weeding. Relationship between the weed biomass and cassava root yield was shown as Y=-3.78 W+30.9, where Y is cassava root yield in fresh weight (t ha^{-1}), W is weed biomass in dry weight (t ha^{-1}) (Figure 1). Coefficient of determination was 0.81.

Discussion

Relationship of weed biomass and cassava root yield was liner. It was same as the result in Africa in 1992-94.[4] Cassava root yield under weed biomass as 0 t ha^{-1} was 13t ha^{-1} in Godfrey-Sam-Aggrey's study and 31t ha^{-1} in this study. This difference is caused by increase of potential yield by improvement of cassava variety. Weed biomass to reach cassava root yield as 0t ha^{-1} was 10t ha^{-1} in Godfrey-Sam-Aggrey's study and 8t ha^{-1} in this study. The amount of weed was difficult to allow cassava establishment.

The linear relationship of weed biomass and cassava root yield suggest certainly simple competition of water, nutrients, root area, etc. Cassava root yield decreases under drought condition.[6–8] Critical level of cassava growth is so low nutrient content.[9] Weed might absorb water and nutrients up to soil condition to restrict cassava growth even in rainy season and with chemical fertilizer application. But,[10] reported competition of water between cassava and weed was moderate to low. Cassava root yield under intercropping with other crops mostly was same as mono cropping, in some case decreased under cropping with groundnuts, cowpea, and maize.[11,12] And, cassava root might be restricted when it meets weed root.

Table 1 Effect of weeding time on weed biomass and cassava root yield

Weeding times	Weed biomass (T Ha-1)			Cassava root yield (T Ha^{-1})		
	Range	Average	Standard deviation	Range	Average	Standard deviation
No weeding	6.1-7.7	6.8 a	0.8	0.5-10.9	4.4 a	4.9
1 time weeding	2.0-5.6	3.3 b	1.6	10.6-25.8	19.3 b	6.3
2 times weeding	0.1-1.2	0.5 c	0.5	22.7-39.4	30.3 b	6.8
3 times weeding	0.0-0.2	0.1 c	0.1	22.7-36.6	29.4 b	5.7

Different characters in average mean different significantly in 0.05 among the treatments using HSD test by Tukey-Kramer.

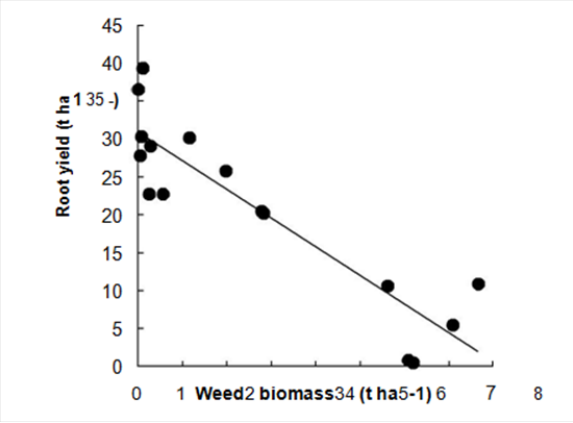

Figure 1 Relationship between weed biomass and cassava root yield.

Citation: Khanthavong P, Oudthachit S, Souvannalat A, et al. Effect of weed biomass on cassava yield related to weeding times. *Adv Plants Agric Res.* 2016;5(5):630–632. DOI: 10.15406/apar.2016.05.00194

Ratio of cassava root yield without weeding compared with appropriate weed control was reported 5-75%.[1–3] In this study, it was 15%, which means reduction effect of cassava root yield by poor weeding management was relatively high. Weed growth might be higher than others due to, for example, a lot of seed bank. Twice weeding, in this study, reduced weed biomass and took good cassava root yield certainly. However, based on our interviews to farmers, the period of 1-2months after planting coincides usually with the sowing period of rice in Lao PDR. Hence, it is difficult to find labor for weeding in the period. As a result, farmer conducted weeding only once. Effective weeding method under low labor input is needed to increase of cassava production in Lao PDR.

Conclusion

The once weeding varied weed biomass in this study. In some case, weed biomass reduced so much with the once weeding. Extension of weeding to farmers should be based on weed biomass not the time of weeding for labor saving on cassava cultivation.

Acknowledgements

None.

Conflict of interest

The author declares no conflict of interest.

References

1. Melifonwu AA. Weed and their control in cassava. *African Crop Science Journal*. 1994;2(4):519–530.
2. Olorunmaiye, Patience PM, Olorunmaiye KS. Effect of integrated weed management on weed control and yield components of maize and cassava intercrop in southern Guinea savanna ecology of Nigeria. *Australian Journal of Crop Science*. 2009;3(3):129–136.
3. Agahiu AE, Baiyeri KP, Ogbuji RO. Structural morphology of Cassava (*Manihot esculenta* Crantz) genotypes influenced yield and responses to weed management in the Guinea savanna zone of Nigeria. *Journal of Applied Biosciences*. 2011;48:3270–3278.
4. Godfrey–Sam–Aggrey W. Effects of delayed hand weeding on sole–crop cassava in Sierra Leone. *Expl Agric*. 1978;14:245–252.
5. Meteorology and Hydrology. Agro–meteorology summery in Lao PDR; 2015.
6. Yao NR, Goué B. Water use efficiency of a cassava crop as affected by soil water balance. *Agricultural and Forest Management*. 1992;61(3–4):187–203.
7. El–Sharkawy MA, Cadavid LF. Response of cassava to prolonged water stress imposed at different stages of growth. *Expl Agric*. 2002;38:333–350.
8. Odubanjo OO. Olufayo AA, Oguntunde PG. Water use, growth, and yield of drip irrigated cassava in a humid tropical environment. *Soil and Water Res*. 2011;6(1):10–20.
9. Howeler RH. Cassava mineral nutrition and fertilization. In Hillocks RJ, et al. editors. *Cassava: Biology, Production and Utilization*. New York: CABI Publishing; 2001. p. 115–147.
10. Aspiazú I., Sediyama T, Ribeiro JI, et al. Water use efficiency of cassava plants under competition conditions. *Planta Daninha*. 2010;28(4):699–703.
11. Mohamed Amanullah M, Somasundaram E, Vaiyapuri K, et al. Intercropping in cassava – A review. *Agric Rev*. 2007;28(3):179–187.
12. Adeniyan ON, Aluko OA, Olanipekun SO, et al. Growth and yield performance of cassava/maize intercrop under different plant population density of maize. *J Agricultural Science*. 2014;6(8):35–40.