

Effect of Cutting and Watering of *Portulaca oleracea* L. on Weeds Control

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Abstract *Portulaca oleracea* L. (*Krokot*) is a weed which have capability to decrease 50% crop production and have a high adaptation on dry and wet land. This research aims to evaluate effect of cutting and watering to suppress *P. oleracea* growth. Randomized design factorial followed by Least Significant Difference (LSD) test were used as research design. Cutting treatment consist of control (P0), cutting primary branch in 40 days after planting (DAP) (P1) and cutting primary branch in 60 DAP (P2). Whereas, watering treatment was design as 100% field capacity (K1), 75% field capacity (K2), 50% field capacity (K3) and 25% field capacity (K4). Results showed that the highest number of *P. oleracea* capsules (2.718) and seeds (135.917) were founded on treatment without cutting and 50% of watering. While the lowest number capsules (351) and seeds (17.533) were found on cutting treatment in 40 DAP and 100% of watering. It can be concluded that combination between cutting and watering significantly affect on branch number, stem diameter, leaf surface area, capsules and seeds number.

Keywords *Krokot*, Weeds, Water availability, Cutting

1. Introduction

Krokot (*Portulaca* spp.) is a xerophyte plant which classified as weeds and well-grown in wet and dry area [1]. This weed often associated with various vegetables such as nut, sweet potato, soybean, corn, tomato, garlic and onion [2]. It cause 50-80% decline in production [3].

This plant can growth so fast vegetatively and generatively [4]. Moreover, *Portulaca* spp. can produce 240.000 seeds in a cycle and able to generate roots on cropped stem [5]. *Portulaca* spp. also have unique photosynthetic process which able to induces crassulacean acid metabolism (CAM) in drought stress [6, 7] and able to do C4 photosynthetic when water is abundant [8].

There are some effective efforts to control *Portulaca* spp. growth; pullout and weeding (before 30 days old). However, stem cutting of *P. oleracea* at 40 and 60 days after planting were done to discover the influence of stem cutting time to capsules maturity. Then, the environment characteristics that support or inhibit growth were analyzed to contribute in weeds control strategy.

2. Materials and Methods

2.1. Research Location

This research was conducted at the green house of Agriculture Faculty, Muhammadiyah University and Analysis procedures were done at Environmental Resources Utilization Laboratorium of Agriculture Faculty, Brawijaya University, Malang, East Java, Indonesia.

2.2. Materials

P. oleracea seedlings were used plants which already grew 4-6 leaves. Planting medium was consisted of a mixture of soil: sand: manure fertilizer (1:1:1) in 15x30 cm polybag.

2.3. Methodology

Randomized design factorial followed by LSD 0.05 and treatment was consist of cutting and watering. Cutting treatment consist of control-without cutting (P0), once cutting primary branch at 40 days after planting (P1) and once cutting primary branch at 60 days after planting (P2). Whereas, watering treatment consist of 100% field capacity (K1), 75% field capacity (K2), 50% field capacity (K3) and 25% field capacity (K4). Both of treatments resulting combination of 12 treatments with 3 repetitions and were observed once in 10 days. Variables which observed in the this group were secondary branches, stem diameter (mm), plants diameter (cm) and root length (cm). Besides, leaf surface area (cm), capsules and seeds number per plant were observed for one life cycle (130 days after planting).

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2.4. Data Analysis

The data were analyzed using t-test at 0.05 level of probability and LSD applied as *post hoc* test to find significant value ($P < 0.05$).

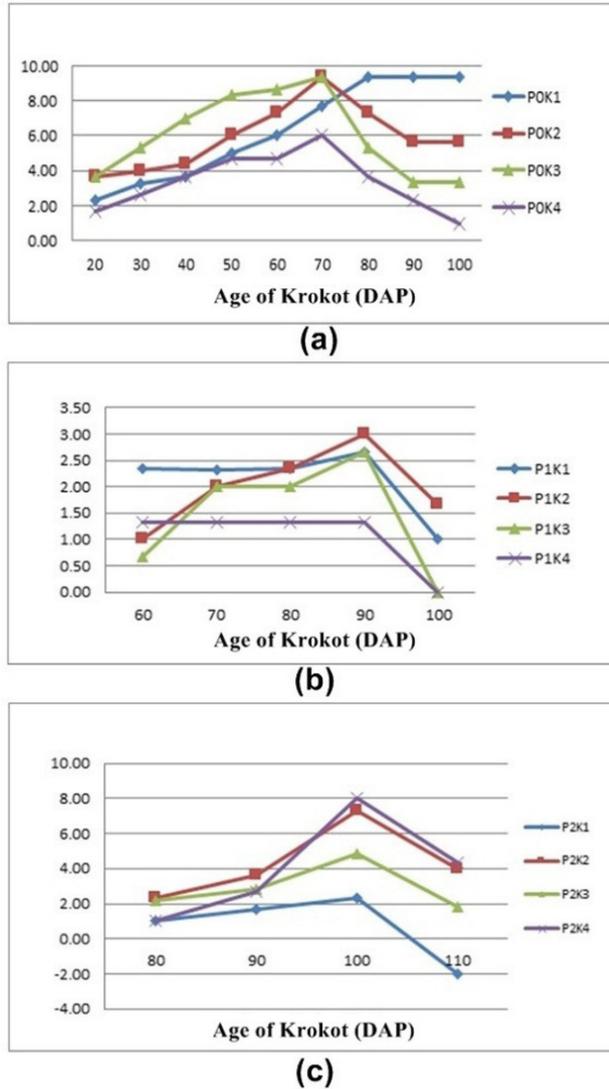


Figure 1. Branches number: (a) without cutting (P0); (b) 40 days after planting; (c) 60 days after planting

3. Result

3.1. Branches Number

There is a significant difference in branch number of cutting treatment and without cutting treatment (P0) (Figure 1). *Krokot* (*P. oleracea*) with cutting treatment showed decrease brach numer at 90 and 100 Dap. It means that there is relationship between cutting and watering variables.

Table 1 showed the differences of *P. oleracea* branches number between 40 and 60 days after planting with 80 days after planting. The lowest number founded on cutting at 60 days after planting (1.63). Watering also have effect to the branches. The lowest number founded on watering treatment at 25% field capacity (K4). However, *P. oleracea* with

cutting at 60 days after planting and water availability 25% - 100% treatments extending the vegetative phase, marked by the formation of new shoots.

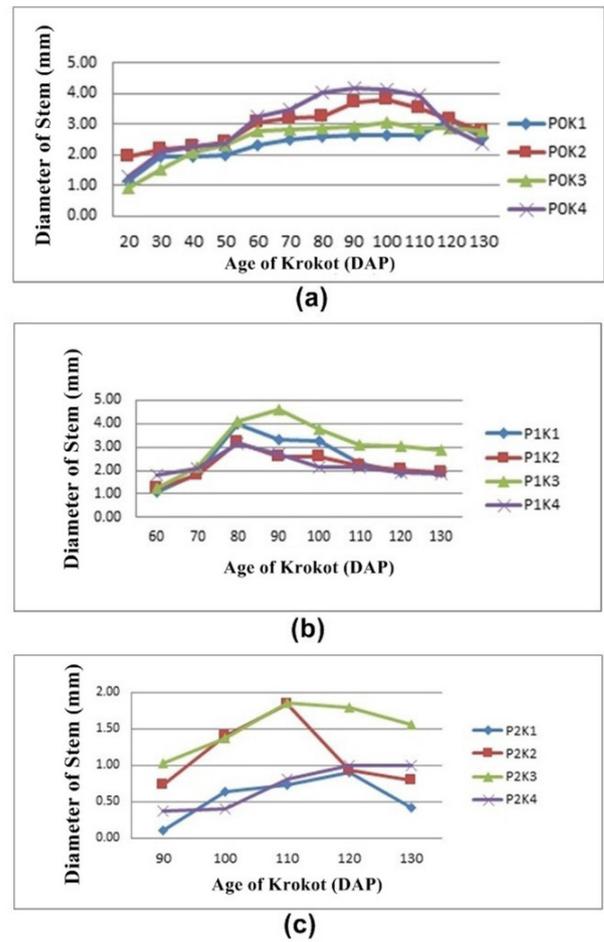


Figure 2. *P. oleracea* stem diameter size: (a) without cutting (P0); (b) Cutting at 40 days after planting; (c) Cutting at 60 days after planting

Table 1. The effect of cutting and watering treatment towards branches number at 80 days after planting

Treatment	<i>P. oleracea</i> at 80 DAP
Cutting	
P0 (Without cutting)	6.42 ^c
P1 (Cutting at 40 days after planting)	2.00 ^b
P2 (Cutting at 60 days after planting)	1.63 ^a
LSD test 5%	
	0.38
Watering	
(K1) 100% field capacity	4.22 ^c
(K2) 75% field capacity	4.00 ^c
(K3) 50% field capacity	3.17 ^b
(K4) 25% field capacity	2.00 ^a
LSD test 5%	
	0.51

NOTE: LSD Least Significant Difference; DAP: Days after Planting

The analysis showed that there is relationship between cutting and watering treatment. *Krokot* without cutting treatment has the highest number of branches.

Relationship analysis were done between cutting and watering treatment at 80 days after planting (Table 2). The highest branches number were found at without cutting treatment with 100% of watering /P0K1 (9.33). While the lowest number was found on cutting treatment at 40 days after planting with 25% watering/P1K4 (1.33) and 60 days after planting with 100% of watering /P2K1 (1.67).

Branches number in 100 days after planting without

cutting and watering treatment at 100% and 75% (P0K1 dan P0K2) did not different to *P. oleracea* aged 90 days after planting (9.33 and 5.67) (Table 2). Conversely, from the treatment of cutting at 60 days after planting still still growing new branches (Table 2).

It is due to *P. oleracea* is a C4 plant which able to turn into CAM process depend on the water availability. This is the reason to be resistant and still produce a number of branches.

Table 2. Interaction between cutting and watering treatment towards branches number at 90 and 100 days after planting with stem diameter size (mm) at 90 days after planting

Treatments	Cutting age		
	Without cutting (P0)	40 DAP (P1)	60 DAP (P2)
90 days after planting			
(K1) 100% field capacity	9.33 ^b	2.67 ^a	1.67 ^a
(K2) 75% field capacity	5.67 ^b	3.00 ^a	3.67 ^a
(K3) 50% field capacity	3.33 ^a	2.67 ^a	2.83 ^a
(K4) 25% field capacity	2.33 ^a	1.33 ^a	2.67 ^a
LSD 5%	2.01		
Treatments	Cutting age		
	Without cutting (P0)	40 DAP (P1)	60 DAP (P2)
90 days after planting			
(K1) 100% field capacity	2.63 ^b	3.33 ^c	0.10 ^a
(K2) 75% field capacity	3.73 ^c	2.60 ^b	0.73 ^a
(K3) 50% field capacity	3.17 ^b	4.60 ^c	1.03 ^a
(K4) 25% field capacity	2.93 ^c	1.70 ^b	0.37 ^a
LSD 5%	0.51		
Treatments	Cutting ages		
	Without cutting (P0)	40 DAP (P1)	60 DAP (P2)
100 days after planting			
(K1) 100% field capacity	9.33 ^b	1.00 ^a	2.33 ^a
(K2) 75% field capacity	5.67 ^b	1.67 ^a	7.33 ^b
(K3) 50% field capacity	3.33 ^b	0.33 ^a	4.83 ^b
(K4) 25% field capacity	1.00 ^a	0.00 ^a	8.00 ^b
LSD 5%	1.87		

NOTE: LSD Least Significant Difference; DAP: Days after Planting ns: not significant

Table 3. The effect of cutting and watering treatment toward stem diameter size (mm) at aged 100 - 130 days after planting

Treatments	<i>P. oleracea</i> ages DAP			
	100	110	120	130
Cutting				
P0 (Without cutting)	3.41 ^a	3.25 ^a	3.02 ^a	2.62 ^a
P1 (Cutting at 40 days after planting)	2.95 ^b	2.43 ^b	2.23 ^b	2.13 ^b
P2 (Cutting at 60 days after planting)	0.98 ^c	1.08 ^c	1.07 ^c	1.11 ^c
LSD test 5%	0.14	0.19	0.21	0.18
Watering				
(K1) 100% field capacity	2.21 ^b	1.86 ^a	1.83	1.62
(K2) 75% field capacity	2.60 ^c	2.26 ^b	2.03	1.83
(K3) 50% field capacity	3.09 ^d	2.96 ^c	2.62	2.48
(K4) 25% field capacity	1.88 ^a	1.93 ^a	1.93	1.88
LSD test 5%	0.19	0.25	ns	ns

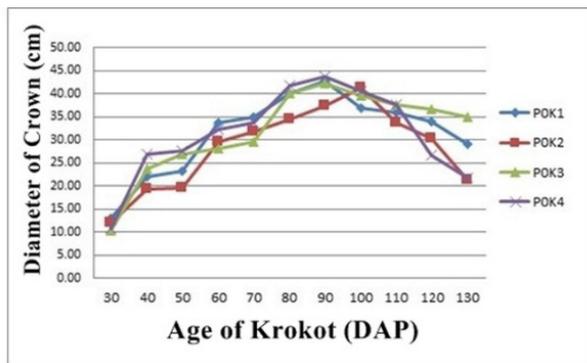
NOTE: LSD Least Significant Difference; DAP: Days after Planting ns: not significant

3.2. Stem Diameter

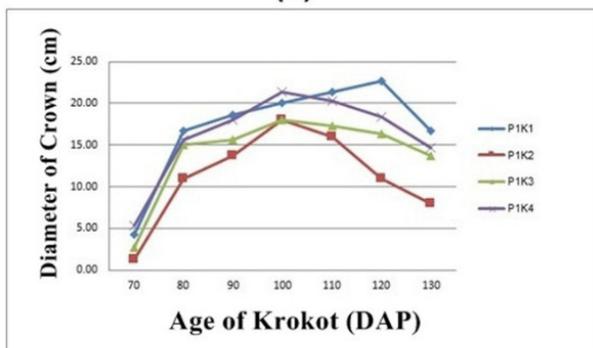
The biggest stem diameter was found on without cutting and 25% watering treatment at 90 days after planting (P0K4) and cutting treatment on 40 and 60 days after planting with 50% water treatment at 90 days after planting (4.60-P1K3) and 110 days after planting (1.86-P2K3) (Figure 2). It shows that cutting at 60 days after planting still allows the growth of stem diameter before entering the stage of death (Table 2).

Combination between cutting and watering treatment toward stem diameter size at 90 days after planting showed that the greatest stem diameter size was founded on cutting treatment at 40 days after planting with 50% watering treatment (4.60 mm).

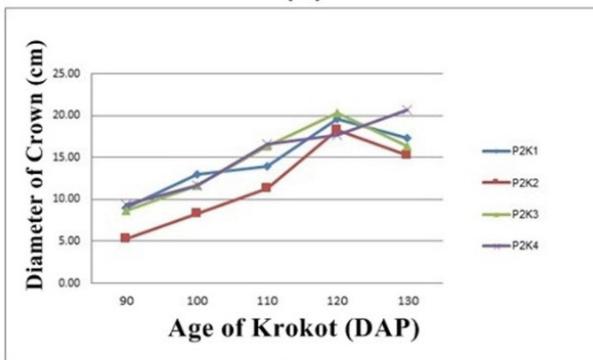
From the statistical analysis (Table 3), stem diameter size were significantly different at plants aged 100 and 110 days after planting because it is still growing.



(a)



(b)



(c)

Figure 3. *P. oleracea*'s crown diameter: (a) Without cutting (P0); (b) 40 days after planting; (c) 60 days after planting

3.3. Crown Diameter

Based on Figure 3a, *P. oleracea* crown diameter growth reached the greatest on the without cutting treatment at 90 days after planting with 25% watering treatment (43,67 cm). If water availability us low, So the crown diameter increased (aged 100 days after planting with 75% and 25% watering treatment) (Figure 3b). Yet, on 25% watering treatment (P2K4), the increase of crown the diameter are still ongoing.

Statistical analysis showed that cutting treatment significantly affect to crown diameter. *P. oleracea* without cutting treatment (P0) generate the greatest diameter (41.50 cm) at 90 days after planting (Table 4). Besides, *P. oleracea* with cutting treatment at 40 days after planting have greater crown diameter.

3.4. Leaf Surface Area

The cutting treatment influenced on leaf surface. *P. oleracea* without cutting and 50% watering treatment (P0K3) has the largest leaf surface (267.96 cm²). The smallest area (44,63 cm²) was founded on cutting treatment at 40 days after planting with 100% watering treatment (P1K1) also on cutting at 60 days after planting with 75% watering treatment (46.39 cm² - P2K2) (Table 5). P0K3 treatment tends to affect in metabolic processes such as the addition of leaf surface.

3.5. Capsules Number

The combination between cutting and watering treatment affect to total capsules number (Table 5). The highest number of capsules were founded at plants without cutting and 50% watering treatment.

P. oleracea can live in all water availability conditions and proved by high number of capsules production at 25% - 50% watering treatment. Otherwise, the small quantities of capsule on cutting treatment at 40 days after planting with 100% watering treatment indicated that water availability will suppress the growth.

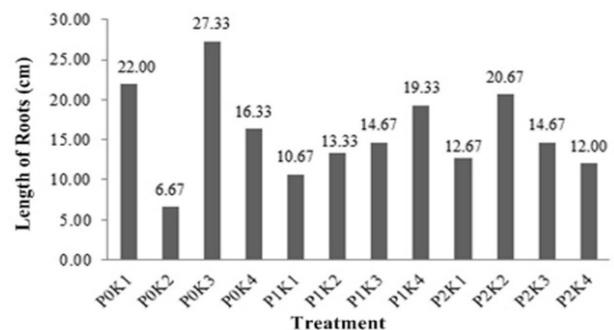


Figure 4. *P. oleracea* root length at 130 days after planting

3.6. Seeds Production

The average number of seeds ranged between 60-80 per capsule. *P. oleracea* at 40 days after planting with 100% watering treatment (P1K1) produce the smallest amount of seeds (17,533), while without cutting and 50% watering treatment (P0K3) generate the highest number of seeds (135,917).

3.7. Root Length

Cutting and watering treatment not significantly affect to root length. In Figure 4, *P. oleracea* without cutting and 50% watering treatment (P0K3) have the longest root (27.33 cm).

4. Discussion

Branch number was influenced by cutting or without cutting treatment. Appropriate to Notani, *et al.*, cutting process also plays an important role for new shoots formation [9]. The increase of branches number will also

affect to the number of capsules and seeds [5]. The cutting at 40 days after planting can be used to suppress branches and capsules production.

Beside that, treatment also influenced the stem diameter because cytokinins on lateral buds are causing differentiation of lateral buds transport tissue [10]. It allows nutrients transport for lateral buds for growing. This related to results of lateral branch number and diameter. *P. oleracea* without cutting treatment have great stem diameter. That because the metabolic activity in plants without cutting treatment was continued. While the plants were cut would stimulate the new shoots [11].

Table 4. The effect of cutting and watering treatment toward crown diameter size at various *P. oleracea* age

Treatments	Crown Diameter (cm)				
	90 DAP	100 DAP	110 DAP	120 DAP	130 DAP
Cutting					
P0 (without cutting)	41.50 ^c	40.08 ^c	36.25 ^c	31.92 ^c	26.83 ^c
P1 (Cutting at 40 DAP)	16.50 ^b	19.33 ^b	18.75 ^b	17.08 ^a	13.25 ^a
P2 (Cutting at 60 DAP)	8.08 ^a	11.17 ^a	14.58 ^a	19.00 ^b	17.42 ^b
LSD 5%	1.68	1.98	1.80	1.71	2.09
Watering					
Water availability 100% KL	23.44	23.89	23.78	25.44	21.00
Water availability 75% KL	18.78	22.56	20.33	19.89	15.00
Water availability 50% KL	22.22	23.11	23.78	24.44	21.67
Water availability 25% KL	23.67	24.56	24.56	20.89	19.00
LSD 5%	ns	ns	ns	ns	ns

NOTE: LSD Least Significant Difference; DAP: Days after Planting ns: not significant

Table 5. Interaction between cutting and watering treatment to leaf surface, capsules and seeds number at 130 days after planting

Treatments	Cutting time		
	Without cutting	Cutting at 40 DAP	Cutting at 60 DAP
(K1) 100% field capacity	187.07 ^c	44.63 ^a	104.95 ^b
(K2) 75% field capacity	120.4 ^b	93.72 ^{ab}	46.39 ^a
(K3) 50% field capacity	267.96 ^b	85.23 ^a	69.08 ^a
(K4) 25% field capacity	144.14 ^a	105.72 ^a	173.05 ^a
LSD test 5%	572.24		
Treatments	Cutting age		
	Without cutting	Cutting at 40 DAP	Cutting at 60 DAP
(K1) 100% field capacity	2086 ^c	351 ^a	1724 ^b
(K2) 75% field capacity	1555 ^b	886 ^a	1748 ^b
(K3) 50% field capacity	2718 ^b	1044 ^a	1539 ^a
(K4) 25% field capacity	2249 ^b	873 ^a	1357 ^a
LSD test 5%	257.96		
Treatments	Cutting age		
	Without cutting	Pemotongan 40 DAP	Cutting at 60 DAP
(K1) 100% field capacity	104,283 ^c	17,533 ^a	86,200 ^b
(K2) 75% field capacity	77,767 ^b	44,283 ^a	87,383 ^b
(K3) 50% field capacity	135,917 ^c	52,217 ^a	76,967 ^b
(K4) 25% field capacity	112,467 ^c	43,650 ^a	67,850 ^b
LSD test 5%	12,898		

NOTE: LSD Least Significant Difference; DAP: Days after Planting ns: not significant

The increasing of leaf surface, leaf thickness reduction and increasing in chlorophyll content enables to capture of light more efficiently. Furthermore, the photosynthesis process is usually proportional to leaf surface for capsule and seeds formation [12]. Yasemin explained that drought stress can decrease the photosynthesis rate occurs due to stomatal closure [13]. However, it did not happened in *P. oleracea* because its ability to photosynthesized on CAM metabolism. According to Galinato *et al.*, *P. oleracea* produce 9,4 seeds per capsule depend on environmental conditions [14-17]. Udin *et al.*, stated that *P. oleracea* is productive weed that resistant to poor environment [18]. These results appropriate to Herdiawan, *et al.*, which state that there is no correlation between drought stress and pruning intervals against root length [19]. *P. oleracea* is an adaptive plant. Long root is strategy to maximize the nutrients and water for capsule production [20].

5. Conclusions

P. oleracea growth can be suppressed by cutting and watering treatment. They combination of treatment can reduce the number of branches, leaf surface, number of capsules and seeds. Cutting also can reduce the crown. However, cutting without watering treatment would affect plants diameter and capsules produced. Moreover, cutting treatment also increase the growth 20 days longer. Cutting at 40 days after planting in 100% water availability can be a strategy for weed control because it can suppress plants growth.

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