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Research Article

Dominant Weeds Diversity in Potato (*Solanum tuberosum* L.) Crop in Garut Regency West Java Province, Indonesia

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Abstract

Background and Objective: The existence of weeds on potato crops could decrease the productivity of the crops, so that weed control efforts were absolutely necessary. The diversity of dominant weed types needed to be known so that weed control could be done correctly. This study aimed to make dominant weed mapping on potato cultivation in Garut regency. **Materials and Methods:** This research was conducted using the quadratic method. Two locations of potato plant areas as samples scattered at different altitude or topographic conditions were randomly selected in each sub-district. At each location the sample was weighed diagonally (5 times) for each plot of potato cropping using the iron squares of size 0.5×0.5 m. Field data was used to determine weed species, weed density, weed frequency, weed domination, importance value, summed dominance ratio, weed dry weight and species diversity index. **Results:** The results showed that the dominant weed species in Cisurupan, Pasirwangi, Cikajang and Cigedug Sub-districts were *Galinosoga parviflora* (29.66%), *Amaranthus spinosus* (34.62%), *Drymaria vilosa* (22.72%) and *Cyperus rotundus* (21,26%), respectively. The value of diversity index of potato crop acquired in Garut regency ranged from 1.46-2.26 including low-moderate. **Conclusion:** This study concluded that weeds in highland potato cultivation in Garut regency were dominated by broad-leaved weeds.

Key words: Dominant weeds species, highland potato cultivation, productivity, potato crop, quadratic method, potato cultivation, weed mapping

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Potato (*Solanum tuberosum* L.) is one of the vegetable crops that got priority in its development because potato has strong competitiveness compared to other vegetables. The role of potatoes in Indonesia is increasing, both as fresh and processed products. Therefore, the position of potato commodities for the future is expected besides being used as a vegetable is also an option to diversify sources of carbohydrates that helped to strengthen food security. Potato productivity in Indonesia in 2014 amounted to 17.67 t ha⁻¹ and in 2015 increased to 18.20 t ha⁻¹. The area of potato harvest¹ in 2014 was 76,291 ha and in 2015 it was 66,983 ha. Nevertheless, potato productivity in Indonesia is still below the productivity of potatoes in Europe reaching² 25.0 t ha⁻¹.

One of the factors causing low yield of potato crop both quality and quantity was weed disturbance. Weeds as plant-disturbing organisms included important constraints to be overcome in increasing horticultural crop production in Indonesia. Weeds were one of the most dangerous factors in agricultural land because it could decrease crop yield. Depending on the level of competition, weeds could reduce yield productivity from cultivated plants between³ 10-25%. In potato plants, if weeds were not controlled, the weeds would reduce damage to potato crops around 54.8%. According to Mubarak *et al.*⁴ weeds that dominated on potato crops were *Cyperus rotundus* and *Ageratum conyzoides*. Meanwhile, according to Sumekar, type of weeds in tomato crop in Majalengka Regency consisted of 8 species; 5 broad-leaved weed species were recorded, i.e., *G. parviflora*, *D. villosa*, *O. trifolia*, *A. conyzoides* and *A. vulgaris*, 2 grass species i.e., *E. indica* and *C. dactylon* and 1 sedges species i.e., *Cyperus rotundus*⁵. Specific weed species were competitors of horticulture plants in getting water, nutrients and light. The diversity of weeds in a cultivation plant was not fixed but varied according to the factors that influenced it, following the general rules of the dynamics of the plant population. Factors affecting the change or diversity of weeds planted in horticulture were different ways of cultivation, control methods and plant stadia that affected the microclimate and season. Horticultural crops were very sensitive to weed disturbance during the critical period of between 1/3 to 1/2 age of the plant⁶, so in that critical period, it needed weed control.

The appropriate weed control program to obtain satisfactory results needed to be considered first. Knowledge of weed biology, factors affecting weed growth, knowledge of

how weeds multiplied, spread and reacted to environmental changes and the way weeds grew in different circumstances was very important to know in determining the direction of the weed control program. Success in weed control should be based on sufficient knowledge of the biological properties of the weed, e.g., (a) By identifying, (b) Searching in the literature on the reference to the weeds and (c) Asking the experts or weeder⁷.

Therefore, the aim of this research was to investigate the dominant weed diversity in potato plantation in Garut Regency area through identification and analysis of weed vegetation.

MATERIALS AND METHODS

The experiment was carried out in the area of horticulture cropping of potato owned by farmers in the region of Garut regency with respective 4 sub-districts and each sub-district was taken 2 villages for experimental field in which the weeds species was analyzed; those were, Pasirwangi sub-district (Padaawas and Barusari village), Cisarupan sub-district (Cisarupan and Karamat Wangi village), Cikajang sub-district (Cikajang and Mekarsari village) and Cigedug sub-district (Cigedug and Sukahurip village). The experiment located in various cultivations, cropping patterns and different weeds controlling. The experiment was carried out in September-November, 2016.

Tools used in the research were squared meters (0.5×0.5 m), scissors, hoes, meters, plastic bags, machetes, analytical scales and drying ovens. Research method used was quadratic method. In each sub-districts would be selected two locations of horticulture cropping area randomly with type of potato crop on two period after planting; as distributed sample in various altitude condition or different topography. In each sample location, the analysis of weeds vegetation was analyzed diagonally (5 times) for each cropping area of potato and chicory with squared meters; the size of used quadrant was 0.25×0.25 m. Data analysis was performed by quantitative analysis to know the diversity index (H').

Weed vegetation analysis was performed by taking weeds from destructive plot of 0.25 m² and grouped per weed species, dry weight per species and total are measured by weighing the dried weed in the oven until reaching the constant weight at the temperature of 80°C. Furthermore, the calculation of weeds importance value (IV), Summed Dominance Ratio (SDR), weeds diversity index, dominance index (D), weeds species and the index of weeds species dominance (D) were with the following formula:

- Weeds Importance Value (IV) was the value obtained from the calculation i.e.:

$$\text{Relative density value of species} = \frac{\text{Absolute density value of species}}{\sum \text{Absolute density value of classes}} \times 100\%$$

$$\text{Relative frequency value of species} = \frac{\text{Absolute frequency value of species}}{\sum \text{Absolute frequency value of classes}} \times 100\%$$

$$\text{Relative dominance value of species} = \frac{\text{Absolute dominance value of species}}{\sum \text{Absolute dominance value of classes}} \times 100\%$$

Important value = Relative density+relative frequency+relative dominance

$$\text{Summed dominance (SDR)} = \frac{\text{Important value}}{3}$$

Weeds species having the biggest SDR value meant that it was dominant weeds.

- Weight dry weeds per species and total dry weight

Observations were made at the time of vegetation analysis by taking from the destructive plot of 0.5 m x 0.5 m and grouped into three groups of weeds, i.e., broad leaves weeds, grasses and sedges. Dry weight was measured by weighing the dried weeds in the oven to 80°C.

- To know the magnitude of Species Diversity Index (H') in a community whose purpose to evaluate the weeds community diversity level in a region was by using the formula. According to Barbour *et al.*⁸ data were processed by using Ecological Methodology Program:

$$H' = -\sum_{i=1}^n (p_i)(\ln p_i)$$

Where:

- pi = ni/N
- ni = Number of important value of one species
- N = Number of important value of all species
- ln = Natural logarithm

In order to the meaning of Species Diversity Index (H') Shannon-Weaver could be interpreted, so the criteria were used. According to Barbour *et al.*⁸, the H' value usually ranged of 0-7. If H'<1 the lowest category. If H'>1-2 low category. If H'>2-3 medium category. If H'>3-4 high category and if H'>4 the highest category.

RESULTS AND DISCUSSION

Summed Dominance Ratio (SDR): Many factors which affected the diversity of weeds community, some of those were soil type, altitude above sea level, technical culture pattern and different environment agro-climate. The spread of weeds was also determined by the difference of altitude. Location on the high land tended to have more populations than low land⁹.

Species of different weeds in each land due to the difference of microclimate involved temperature, water condition, light intensity, wind, landscape and season (dry season or rainy season). This was affirmed by Kurniawati, the weeds growing in the area which had good and fertile soil condition and they fitted with living requirement of weeds, then the weeds would grow fruitfully¹⁰. In accordance with Meilin¹¹, species of weeds growing and dominating in an area depended on local climate and location. Weeds vegetation growing in an area would be varied with the other regions although with similar cultivated plants.

Data on Table 1 indicated that weeds species existing on potato crop in Cisarupan sub-district were 11 species recorded: 6 species of broad leaves, 4 species of grasses and 1 species of sedges. Dominant weeds species in Cisarupan sub-district i.e., broad leaves weed *Galinsoga parviflora* (29.66%) and 1 sedge of *Cyperus rotundus* (13.54%). Weeds species on the potato crop in Pasirwangi sub-district were 10 species, consisted of 5 species of broad leaves, 4 species of grasses and 1 species of sedges. Dominant weeds species in Pasirwangi sub-district were broad leaves *Amaranthus spinosus* (34.62%) and *Galinsoga parviflora* (14.39%) and 1 species of grasses *Cyperus rotundus* (22.04%). Weeds species on potato crop in Cikajang sub-district are 11 species, consisted of 8 species of broad leaves, 2 species of grasses, 1 species of sedges. Three weeds species in Cikajang sub-district which were dominant from the species of broad leaves were *Drymaria vilosa* (22.72%), *Galinsoga parviflora* (21.17%), *Artemisia vulgaris* (13.67%), and *Oxalis latifolia* (11.8%). Whereas, weeds species on potato crop in Cigedug sub-district were 14 species, consisted of 11 species of broad leaves, 2 species of grasses and 1 species of sedges. Weeds species in Cigedug sub-district which were dominant from the species of sedges *Cyperus rotundus* (21.26%) and 3 weeds of broad leaves *Oxalis latifolia* (19.73%), *Artemisia vulgaris* (10.86%) and *Drymaria vilosa* (10.34%).

Species of weeds existing on potato crop among the sub-districts were distinguished. The difference of weeds

Table 1: Weeds dominance on potato crop in Garut regency

Species	Summed dominance ratio (%)			
	Cisurupan sub-district	Pasirwangi sub-district	Cikajang sub-district	Cigedug sub-district
<i>Altenanthera sessilis</i>	5.73	-	-	-
<i>Amaranthus spinosus</i>	3.71	34.62*	8.32	2.58
<i>Artemisia vulgaris</i>	-	-	13.67	10.86
<i>Biden pilosa</i>	-	-	3.59	6.02
<i>Blumea lacera</i>	-	-	-	5.51
<i>Borreria latifolia</i>	-	-	3.10	1.08
<i>Commelina diffusa</i> Burm. F.	-	-	3.56	2.05
<i>Cynodon dactylon</i>	2.77	4.27	6.10	3.10
<i>Cyperus rotundus</i>	13.54	22.04	4.31	21.26*
<i>Drymaria vilosa</i>	-	-	22.72*	10.34
<i>Dygitaria ciliaris</i>	1.58	3.27	-	-
<i>Echinochloa colona</i>	2.66	2.12	-	1.08
<i>Eragron sumatrensis</i>	-	-	-	3.30
<i>Eleusine indica</i> L.	25.60	9.93	1.65	-
<i>Galinsoga parviflora</i>	29.66*	14.39	21.17	6.97
<i>Hieracium aurantiacum</i>	3.01	1.55	-	-
<i>Oxalis latifolia</i>	9.56	-	11.80	19.73
<i>Poa annoa</i>	-	3.61	-	-
<i>Portulaca oleracea</i>	2.18	4.19	-	6.13
Total domination value	100	100	100	100
Number of species	11	10	11	14

*Dominant weeds

Table 2: Weight dry weeds per species and total in potato crops in Garut regency

Species	Weight dry weeds (g/0.25 m ²)			
	Cisurupan sub-district	Pasirwangi sub-district	Cikajang sub-district	Cigedug sub-district
Broad leaves weeds				
<i>Galinsoga parviflora</i>	17.94	3.74	45.10	17.30
<i>Hieracium aurantiacum</i>	0.01	0.06		
<i>Altenanthera sessilis</i>	0.78			
<i>Portulaca oleracea</i>	0.13	0.83		1.50
<i>Amaranthus spinosus</i>	0.51	17.43	26.30	1.30
<i>Oxalis latifolia</i>	1.40		3.30	6.50
<i>Poa annoa</i>		0.46		
<i>Artemisia vulgaris</i>			11.20	9.90
<i>Drymaria vilosa</i>			20.30	11.20
<i>Commelina diffusa</i>			0.80	2.00
<i>Biden pilosa</i>			1.80	4.80
<i>Borreria latifolia</i>			1.50	0.80
<i>Blumea lacera</i>				3.00
<i>Eragron sumatrensis</i>				3.70
Grasses				
<i>Eleusine indica</i>	13.48	4.25	14.00	
<i>Dygitaria ciliaris</i>	0.19	1.07		
<i>Echinochloa colona</i>	0.57	0.39		0.10
<i>Cynodon dactylon</i>	0.71	2.50	2.60	2.90
Sedges				
<i>Cyperus rotundus</i>	5.65	16.16	3.40	35.20
Total	41.37	46.89	130.30	100.20

species was caused by the existence of differentiation in plant management, e.g., plant pattern and weeds controlling and morphologically different nature from components of composing plant which could change microclimate so that it inflicted different response from each of weeds species¹².

Weight dry weeds per species and total dry weight: The data in Table 2 showed that weed species with the highest dry weight in the potato area in Cisurupan sub-district with broad leaves weed was *Galinsoga parviflora* and grass was *Eleusine indica*. The weed species that had the highest dry weight in

Table 3: Index of species diversity on potato area in Garut regency

Species	Cisurupan sub-district		Pasirwangi sub-district		Cikajang sub-district		Cigedug sub-district	
	1	2	3	4	5	6	7	8
<i>Galinsoga parviflora</i>	0.37	0.36	0.29	0.29	0.32	0.34	0.17	0.23
<i>Eleusine indica</i> L.	0.37	0.33	0.23	0.25		0.10		
<i>Hieracium aurantiacum</i>	0.11		0.09					
<i>Alternanthera sessilis</i>	0.22	0.12						
<i>Portulaca oleracea</i>	0.14		0.15	0.09			0.24	0.11
<i>Amaranthus spinosus</i>	0.11	0.14	0.36	0.37		0.27		0.14
<i>Oxalis latifolia</i>	0.14	0.27			0.22	0.30	0.34	0.30
<i>Cyperus rotundus</i>		0.32	0.34	0.34	0.18		0.36	0.23
<i>Dygitaria ciliaris</i>		0.08		0.15				
<i>Echinocloa colona</i>		0.12		0.11			0.07	
<i>Cynodon dactylon</i>		0.12	0.19		0.18	0.18	0.12	0.11
<i>Poa annoa</i>			0.16					
<i>Artemisia vulgaris</i>					0.33	0.19	0.28	0.20
<i>Drymaria vilosa</i>					0.33	0.34		0.33
<i>Commelina diffusa</i>					0.13	0.10		0.12
<i>Biden pilosa</i>					0.16			0.25
<i>Borreria latifolia</i>					0.13	0.10		0.07
<i>Blumea lacera</i>							0.22	
<i>Erageron sumatrensis</i>								0.17
Total	1.46	1.86	1.81	1.60	1.99	1.91	1.80	2.26

1: Cisurupan village, 2: Kramat Wangi village, 3: Padaawas village, 4: Barusari village, 5: Cikajang village, 6: Mekarsari village, 7: Sukahurip village, 8: Cigedug village

the potato area in Pasirwangi sub-district were broad leaves weed is *Amaranthus spinosus* and sedges is *Cyperus rotundus*. Species of weeds that had the highest dry weight in potato area in Cikajang sub-district were broad leaves weeds were *Galinsoga parviflora* and *Amaranthus spinosus* and grass was *Eleusine indica*. While weed species that had the highest dry weight in potato area in Cigedug sub-district were broad leaves weeds were *Galinsoga parviflora* and *Drymaria vilosa* and sedges was *Cyperus rotundus*.

Total weed dried weight in potato area in Cisurupan sub-district was 41.37 g, in Pasirwangi sub-district was 46.89 g, in Cikajang sub-district was 130.30 g and in Cigedug sub-district was 100.20 g.

The highest total weed dry weight in sub-district was 130.30 g. According to Pramuhadi *et al.*¹³, weed dry weight on cropping tended to increase with increasing soil renewal intensity but tended to decrease with increasing intensity of land piracy. In Cikajang sub-district, weeds were dominated by broad leaves weeds, thus having the highest dry weight. Broad leaves weeds had a larger shape, so it was resistant to shade. Broad leaves weeds had dense canopy and the incoming light intensity for photosynthesis could take place optimally compared to sedges and grasses. According to Gardner *et al.*¹⁴, the development of weeds was a complex combination of growth processes that led to the accumulation of dry weight of plants. This was because the dry weight was greatly influenced by the vegetative growth of weeds, if the vegetative growth increased, then weed dry weight would also increase.

Index of species diversity: On Table 3, there was an adequately clear difference among the range of existing value in some locations of potato fields observation. In each of observed villages, it indicated the almost similar value. The significance of index value of species diversity (H') could be interpreted, so the criteria were used. According to Barbour *et al.*⁸, H' value usually ranged from 0-7. If $H' < 1$, it was the lowest category. If $H' > 1-2$, it was low category. If $H' > 2-3$, it was medium category. If $H' > 3-4$, it was high category and if $H' > 4$, it was the highest category⁸. The index value of potato crop diversity on Table 3 was obtained in Cisurupan sub-district, Pasirwangi sub-district, Cikajang sub-district and Cigedug Sub-district. Sukahurip village indicated the almost similar value where the value of species diversity index was included in low category due to the weeds which has the species were almost similar so that the diversity was low and the productivity got very low as the indication that there was the heavy pressure and unstable ecosystem, except in Cigedug sub-district. Cigedug village was included in medium category because the weeds which had the species were composed of some species.

This condition showed that ecosystem was in the state of being sufficient and balanced, sufficient production and moderately ecological pressure¹⁵. A community was said to have the high diversity if the weeds community was composed by many species with the abundance of similar species. On the contrary, if a community was composed by a little bit of species and only a few dominant species so that the diversity of species was low¹⁶.

The value of species diversity index obtained on the potato cropping area in Garut regency was between 1.46 and 2.26 including low to medium category. The figure showed that the level of species diversity in the research area including low to medium category where a weeds community was composed by some species. Soegianto¹⁷ stated that a community would have the high species diversity when in such a community, there were many species with the abundance of species which was almost equal and vice versa.

CONCLUSION

The results showed that the dominant weed species found on the potato area was *Galinosoga parviflora* (29.66%) in Cisurupan, *Amaranthus spinosus* (34.62%) in Pasirwangi, *Drymaria vilosa* (22.72%) in Cikajang and sedges *Cyperus rotundus* (21.26%) in Cigedug subdistrict. The value of diversity index of potato crop acquired in Garut regency ranged from 1.46-2.26 including low-moderate, showed that community has moderate species diversity.

SIGNIFICANCE STATEMENT

This study discovered the several dominant types of weeds found in potato field in Garut Regency, which can be useful to determine an effective and efficient weed control program. This study could help researchers to uncover the characteristics of dominant weeds that could affect the yield of potato crops. So the new theory of the diversity of dominant weeds in potato cultivation could be known.

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