Weed management assessment for public flower beds©

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Abstract

A lack of participants and techniques for weeding of flowerbeds in public spaces has multiplied the difficulties inherent in local social gardening. This study was conducted to ascertain a weed threshold for management of flowerbeds in public spaces from the relation between flower plant growth and the amount of weeds remaining after weed removal activities. We planted blue salvia seedlings (*Salvia farinacea*) in a field. Later, at 31 days and 85 days after transplantation of the plants, we measured the blue salvia plant height and plant coverage. Additionally, we measured the dry matter weight of remaining weeds after 20 people had removed weeds from flowerbeds. Results show that remaining weed dry matter weight and rate of remaining weeds at 31 days after transplantation were 1.4 g m^{-2} and 1.6% when the plant height and plant coverage of blue salvia were 10.4 cm and 8.3%. The same measures at 85 days after transplantation were 10.8 g m^{-2} and 18.2% when the plant height and plant coverage of blue salvia were 47.9 cm and 56.0%. A significant positive correlation was found between the blue salvia plant coverage and the rate of remaining weeds. Results obtained using linear regression suggest a remaining weed threshold for flowerbed management based on the plant coverage of the flower plants being planted.

INTRODUCTION

For over a decade in Japan, home gardening has remained among the top 20 most popular leisure activities (Japan Productivity Center, 2015). Moreover, gardening volunteer activities by which local residents proactively manage flowerbeds in public spaces, such as local resident parks and streets, have become important social welfare activities to ensure the cleanliness, health, and safety of residential areas. However, shortages of participants and technical deficits are looming difficulties related to social gardening activities in Japan, including gardening volunteerism, because of age and a lack of new participants in activities (Otake et al., 2008; Yamazaki et al., 2011). Continuity has loomed as a daunting future difficulty (Mitarai et al., 2011, 2012). People managing flowerbeds in public spaces as social gardening activities have pointed out specific difficulties such as a shortage of participants, lack of time, and the high frequency of management activities during times of weeding flowerbeds (Iwamura and Yokohari, 2000). An minimum indispensable weeding frequency that managing members and spectators of open space flowerbeds must observe should be proposed. That effort must be sufficient to provide a “clean” area after weeding of flowerbeds in public spaces. Then weed management technologies must be developed to maintain social gardening activities.

A theory of economic thresholds can be referred from harvest sales revenue data and weeding expenses for weed control during crop production (Auld et al., 1987; Coble and Mortensen, 1992; Wilkerson et al., 2002). Similarly, a weed threshold for open space flowerbed weed management might be regarded as the degree to which remaining weeds are recognized as “clean” by spectators and management members.

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To date, rating scales such as semantic difference (SD) methods have been used for recognition of feelings such as "clean" (Osgood et al., 1957; Xiong et al., 2006; Ichihara, 2009). However, it is necessary to show recognition of feelings as "clean" in absolute measures such as the amount of weeds before or after weeding for the assessment of weed management techniques. We attempted to present a valid "remaining weed threshold" for managing flowerbeds based on the amount of weeds remaining after flowerbed weeding.

MATERIALS AND METHODS

A flowerbed was set up in a field of Tokyo University of Agriculture, Faculty of Agriculture in Atsugi city, Kanagawa prefecture. A 1.3×9.0 m section was set aside in the field. Then, the section was separated into 20 small 0.6×0.9 m plots. Blue salvia (*Salvia farinacea* Benth.; Sakata Seed Corp., Japan) was chosen as the flower to be cultivated in the flowerbed during summer. Blue salvia seeds were planted in cell trays of 180 holes on 21 May 2015. The growing seedlings were transplanted in 0.3×0.3 m into all plots on June 30. The plant height and plant coverage of blue salvia were measured in all plots at the time of 31 days and 85 days after transplantation. The plant coverage shows the rate of cover of blue salvia per small plot. Then, about 20 people weeded the small plots. We took all remaining weeds after weeding by the people. The weeds that were taken by the people and the remaining weeds which we took were put in separate envelopes for each plot. Those envelopes and the weeds inside were dried at 80°C 48 h. Then the dry weights of those weeds were measured. We calculated the rate of remaining weeds, which is the ratio (percentage) of the remaining weed dry matter weight to the total weed dry matter weight.

RESULTS AND DISCUSSION

Plant heights of blue salvia were, respectively, 10.4 and 47.9 cm at 31 days and 85 days after transplantation (Table 1). Plant coverage of blue salvia was, respectively, 8.3 and 18.2% at 31 and 85 days after transplantation (Table 1). Weed dry matter weights at the time of weeding by the 20 people were, respectively, 94.8 and 41.7 g m^{-2} at 31 days and 85 days after transplantation (Table 1). The remaining weed dry matter weights after weeding by about 20 people were 1.4 and 10.8 g m^{-2}, respectively, at 31 days and 85 days after transplantation (Table 1). The rates of remaining weeds were 1.6 and 18.2%, respectively, at 31 and 85 days after transplantation (Table 1). A significant positive correlation (P<0.01) was found between plant coverage of blue salvia and the rate of remaining weeds. Additionally, linear regression between these parameters revealed $y = 0.31x - 0.13$ (Figure 1). Furthermore, a significant positive correlation (P<0.01) was found between the blue salvia plant height and the rate of remaining weeds (Figure 2).

Table 1. Condition of blue salvia and weed at the time of weeding.

	31 days after transplanting[1]	85 days after transplanting
Plant growth of blue salvia		
Plant height (cm)	10.4±2.1	47.9±4.0
Plant coverage (%)	8.3±1.9	56.0±12.5
Weed		
Dry matter weight of weeding (g m^{-2})	94.8±33.5	41.7±22.3
Dry matter weight of remaining weeding (g m^{-2})	1.4±1.9	10.8±13.7
Rate of remaining weed (%)	1.6±1.8	18.2±14.7

[1]Mean±standard deviation 31 and 85 days after transplanting are, respectively, July 31 and September 23.

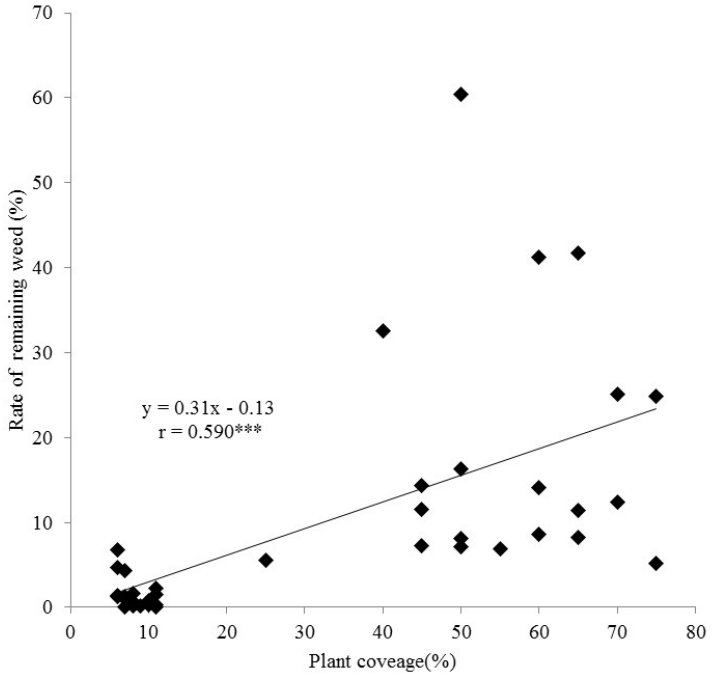

Figure 1. Relation between plant coverage of blue salvia and rate of remaining weeds.

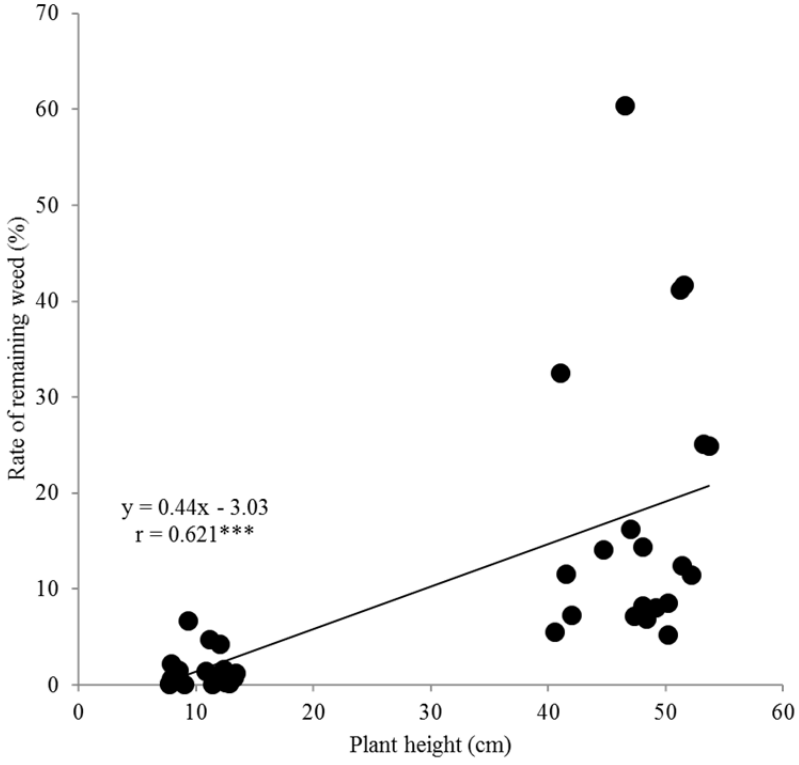

Figure 2. Relation between plant height of blue salvia and rate of remaining weeds.

The rates of remaining weeds show the extent of remaining weeds after weeding by about 20 people. This is the amount of remaining weeds judged as leaving the

flowerbed “clean” after weeding by the people. This study found a significant positive correlation between plant height or plant coverage of blue salvia and the rate of remaining weeds (Figures 1 and 2), suggesting that the remaining weed threshold is presented by measuring the plant height of flowering plants planted in flowerbed of the open space. In addition, results of this study suggest that the amount of allowable remaining weeds might be greater with increasing plant height. This point must be examined for support of future studies because the only test plants were blue salvia. This study did not evaluate the actual activity of gardening volunteers. However, some possibility exists of measuring the available presentation interval and amount of weeding based on plant height or plant coverage of flowering plants transplanted in a flowerbed.

Weed management of flowerbeds in public spaces such as local resident parks and streets is indispensable for the expansion of gardening activities in the private or public domain. The period of weed-free maintenance necessary to keep an economic threshold of weeds that is well-known as a low yield cause of the crop has been presented for some crops in weed management (Hauser et al. 1975; Noguchi, 1983). However, it is necessary for control of weeds that spectators and management members regard it as being “clean,” in conjunction with the control of weeds to poor growing flower plants, in flowerbeds for retention of the landscape and amenity space. Few reports of the relevant literature have described studies of weed management of flowerbeds (Steven et al., 1997; Beddes and Hratsch, 2008) because it is not weed management in agriculture for human life support. The results of our experiment present new possibilities for establishing a basis of weed management technology in terms of the sense of what is “clean” to people in flowerbeds in amenity spaces.

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