Response of Ornamental Chili Pepper *(Capsicum spp.)* to Pot Material and Pruning Frequency in the Green Roof System

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***Abstract*—Objectives of the research were to study the appropriate pot material and pruning frequency in order to obtain optimal growth and yield of ornamental chili pepper in the green roof system. The treatment used a Randomized Block Design (RBD), which comprised of a treatment using 3 material container and 3 levels of pruning by 3 replications. There were 3 pruning intensities that included twice, once, and without any pruning by using 3 kinds of material container, such as clay pot, plastic pot, and polybag, so that 27 combinations of treatment were obtained. Observation was conducted both destructively and non-destructively, which included growth and yield components (height of plant, number of leaf, leaf area, initiation of flowering, initiation of fruit emergence, and numbers of branch) at 14 to 86 dap. Observation was done once in 2 weeks and 6 times observations at 2, 4, 6, and 8 w.a.p. (week after planting) for growth component. Whereas, the yield component, number of total fruits, and weight of fruit were performed at 10 and 12 wap. Twice pruning in polybag may affect on all parameters of growth and optimal yield in comparison with other treatments.**

***Index Terms*—bolivian rainbow pepper, urban farming, roof garden, plant container, pruning**

I. Introduction

Utilization of rooftop for garden has become the urban trend as a response to limited urban land and to fulfill the demand for food. Challenge in rooftop gardening is higher temperature, wind blows harder, lower humidity, and higher radiation intensity thatgardening at the field. Besides that, such material has become the limiting factor for security of the building. The selected container and material should be lighter for security ideal weight of the building's load. Ratio of materials for charcoal: cocopeat: compost = 1:1:1 has lighter weight for about 32.66% in comparison with the soil in water-saturated condition that promote optimal growth on sweet potato [1].

Pruning may reduce height of the plant and produce optimal production by promoting the growth of lateral branches. It is expected that lower height may resist the wind blows at the rooftop garden. Ornamental chili does not only contain vitamin C, vitamin A, potassium, capsaicin, and piperin, but also aesthetic value. In general, ornamental chili is grown in soil. But, in this research, the ornamental chili will be examined using 3 types of common material containers, which are easily found. Those containers are: clay pot, plastic pot, and polybag. It is expected that those three containers may support and promote the growth of ornamental chili on the rooftop at temperature 3^{o}C higher than in the ground. Various types of pots are in clay pots, plastic pots and polybags will affect the temperature around 1-4 ^{o}C on the roof. Differences in soil temperature in pots affect much soil moisture and thermal conductivity. Based on plant growth factor, type of pot effect on porosity, water tension and absorption nutrient of plant. Objectives of the research were to study the effect of growth and yield of the ornamental chili pepper in roof garden system by the use of three material containers and pruning frequency, twice, in polybag that show optimal growth and yield.

II. Materials and Methods

The research was conducted from June to October 2016 in Malang, East Java at the altitude of 700 m asl (meter above sea level). For the climatic conditions, minimum temperatures range 18-24^{0}C and maximum temperatures range 28–32^{0}C, while humidity is about 75 - 98% and average rainfall is about 875-3000 mm per year. The pot laid on 4 meter above the ground surface. Tools used in this research were clay pot, plastic pot, and polybag by 18 cm in diameter, scissors, lux meter, thermometer, and thermohygrometer. Materials of the research included seeds of ornamental chili (*Bolivian Rainbow*) by the age of 6 weeks after seedling, soil, compost, NPK fertilizers by dose of 2 gram/plant, FetrilonCombi 1 (micro nutrient for plant) and pesticide. Data for weight of container and planting medium is presented in Table I.

TABLE I. Fresh Weight of Container and Planting Medium

Container	Weight of Container (g/container)	Weight of Medium (Soil + Compost) (g/pot)	Weight of Container +Medium (Compost + Soil) (g/container)
Clay Pot	800	1420	2770
Plastic Pot	72.3	1420	2042.3
Polybag	9.3	1420	1979.3

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The research used Randomized Block Design (RBD) that comprised of 9 treatments and 3 replications. Treatment combinations of the research were as follow : once pruning + clay pot (K1), once pruning + plastic pot (K2), once pruning + polybag (K3), twice pruning + clay pot (K4), twice pruning + plastic pot (K5), twice pruning + polybag (K6), without pruning + clay pot (K7), without pruning + plastic pot (K8), and without pruning + polybag (K9). Parameters that were observed in the research included leaf area (cm^2), numbers of branch, plant height, total weight of plant, dry weight of the plant's root, fresh weight of fruit, and numbers of fruit. Data of the research will be analyzed using F-test at level 5% in order to find out variances of treatments on growth and yield of the ornamental chili pepper. If results for analysis of variance showed significant difference, it will be followed by LSD (Least Significant Difference) test at level 5%.

III. Results and Discussions

A. Leaf Area per Plant

Pruning frequency and types of material container affect on leaf area of ornamental chili pepper at 2, 4, 6, and 8 wap (week after planting), but pruning frequency and types of material container do not show any significant effect at 10 wap. Average numbers of leaf in accordance with pruning frequency and types of container are presented in Fig. 1a. Results of the research showed that at 6 and 8 wap, K6 produced higher yield than other treatments, but K6 did not show any significant difference with the treatments of K5 and K7. Leaf is the main organ to intercept light and where the photosynthetic takes place. Leaf produces assimilate (source), which is translocated to other organs of the plant (sink) [2].

B. Number of Branches per Plant

Observation on numbers of branch in ornamental chili pepper was done by counting the amount of lateral shoots, which may promote formation of the branch. Results of the research showed that numbers of branch, by the treatment of pruning and material container at 2-8 wap, as well as twice pruning in polybag (K6) showed higher yield than other treatments. Numbers of leaf were also affected by numbers of branch due to more branches may produce more leaves and increase leaf area. If more branches grow at the axil, so that more vegetative organs, such as leaf where photosynthetic takes place, will be formed [3]. If the plant did not get such pruning, its lateral shoots will be the shortest. It is due to apical domination, so that the growth may be centered on apical shoot. However, on the pruned plant, length of its lateral shoot may beyond the control due to the apical domination was broken down as a result of shoot pruning. After shoot pruning, no more auxin supplied from the apical shoot, so that the auxin level will be reduced [4].

C. Plant Height

Results of the research showed that pruning frequency and types of material container affect on height of plant at 6 and 8 w.a.p., but pruning frequency and types of material container did not show any significant effect at 2 and 4 w.a.p. Average height of the plants in accordance with pruning frequency and types of material container are presented in Fig. 1c. At 6 w.a.p., treatment without pruning + plastic pot (K8) showed higher yield than other treatments. At 8 w.a.p., the treatments of K1 and K4 showed lower height than K7, K8, and K9, while K7 did not show any significant difference with K2, K3, K5, and K6. Shoot pruning in chili may inhibit the growth of apical shoot, so that the plant could not grow higher [5].

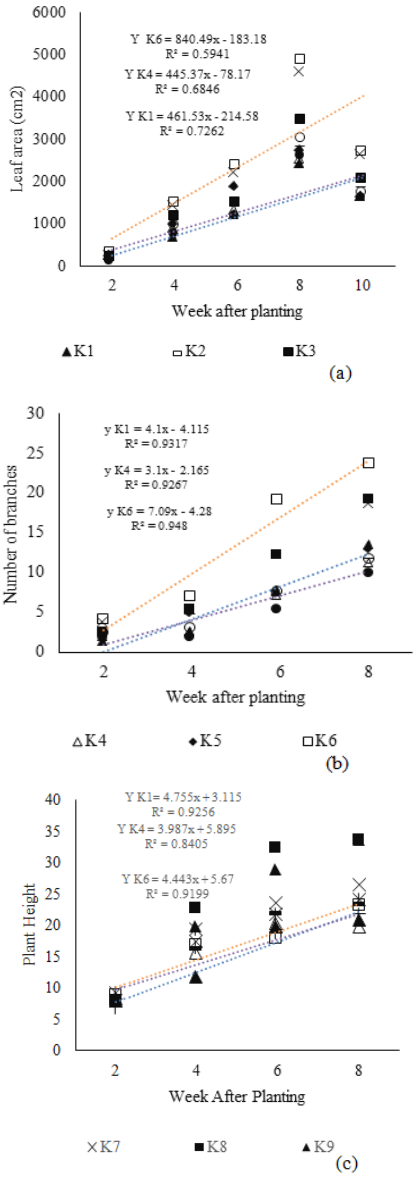

Figure 1. (a) Leaf area, (b) numbers of branch and (c) plant height in ornamental chili pepper

D. Dry Weight of Plant and Dry Weight of Plant's Root

Fig. 2 shows that dry weight of plant's root is higher by the treatment of twice pruning + polybag (K6) than other treatments. Also, total dry weight of the ornamental chili pepper was higher and showed significant difference by the treatment of twice pruning + polybag (K6) in

comparison with other treatments (K1, K2, K3, K4, K5, K7, K8, and K9). By the application of polybag, more roots of the ornamental chili pepper will be produced than using plastic pot and clay pot. Polybag is the lightest container than clay pot and plastic pot, so that it is very suitable to be applied in rooftop system. Polybag is elastic, so that roots of the ornamental chili pepper will grow well and spread out, particularly the secondary roots and the root hairs, therefore the roots will grow faster and much nutrients will be absorbed by the plant and, of course, the plant will grow optimal. The high densities of lateral roots have high total area of xylem per cross-sectional part of the root and affect on fruit yield [6].

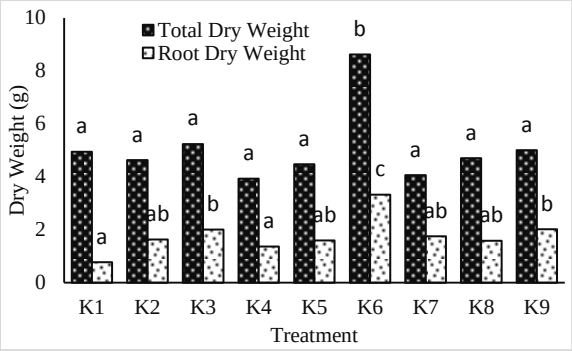

Figure 2. Total dry weight of plant and dry weight of root

E. Fresh Weight of Fruit and Number of Fruit in Ornamental Chili Pepper

Number of fruit and weight of fruit in ornamental chili pepper by the treatment of twice pruning in polybag (K6) showed higher yield and had significant difference than other treatments. Results of the research showed that the plant growth, without pruning in clay pot (K7), was lower than by the treatment of twice pruning in polybag (K6) (Fig. 3). It was due to the increase number of leaf in plant, which was been pruned on its tip and followed by the increase amounts of the formed fruit [7]. Clay pot could pass through the excessive water as a result of watering or raindrops, so that it will avoid excessive moisture in planting medium. However, it is very different from condition when using clay pot in roof garden system [8]. Clay pot may have higher temperature when it is placed on the second floor (roof garden) in comparison with temperature at the first floor (ground surface), so that temperature at the roof is higher than at the ground (surface). It is due to evapotraspiration and reflection of sunlight radiation, therefore the clay pot is easily dried [9]. One of factors that must be concerned in roof garden system is using light pot or container. Plastic pot has become an alternative of choices, as well as polybag, fiberglass or wood [10]. It conformed to results of the research using roof garden system, in which polybag showed better yield than using plastic pot and clay pot.

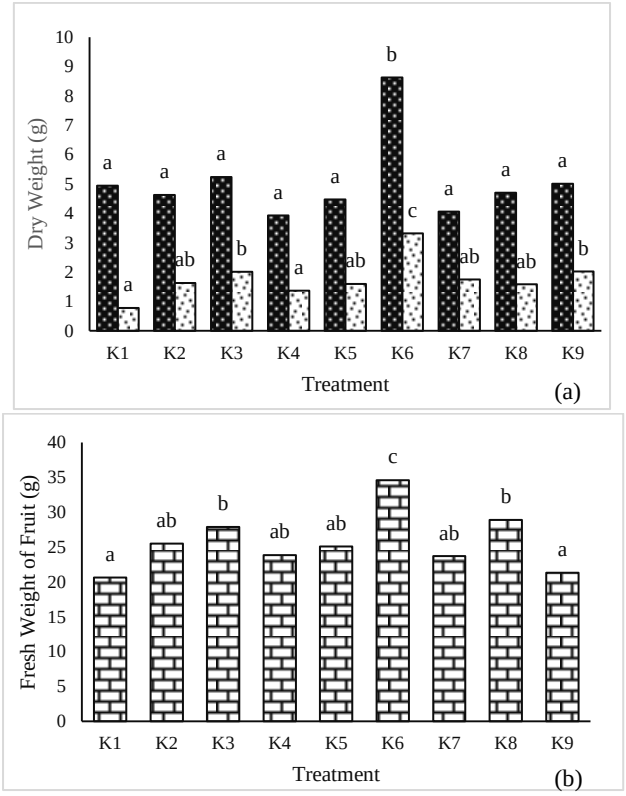

Figure 3. (a) Fresh weight of fruit and (b) number of fruit in ornamental chili pepper

IV. Conclusion

In the Rooftop environment, twice pruning in polybag may increase numbers of fruit and fresh weight of fruit/plant in comparison with treatment without pruning in clay pot and plastic pot. The best response of ornamental chili plant on the treatment of pruning 2 times on polybag, has a leaf area of 39%, the number of branches 50% and the amount of fruit by 29% compared with the treatment without pruning on clay pot. The wet weight on polybags using compost and soil planting media has a lighter weight (74.68%) compared with clay pots.

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