Application of manure types in breeding several varieties of chili (*Capsicum frutescens* L.)

M S Yuliartini*, A A N M Wirajaya, A U R Z Assegaf and Y P Situmeang

Faculty of Agriculture, Warmadewa University, Denpasar-Bali, Indonesia

*yuliartinisri@yahoo.co.id

**Abstract.** The study aims to determine the effects of giving several types of manures on various chili pepper varieties. The experiment is a factorial experiment using a randomized block design (RBD) consisting of two treatment factors, namely type of manure (R) of 3 levels: R1 = Chicken Manure, R2 = Cow Manure, R3 = Rabbit Manure and type of varieties (V) of 4 levels: V1 = Genie varieties, V2 = Dewata varieties, V3 = Sigantung varieties, V4 = Gendut varieties. The interaction of varieties and type of manure as a very significant effect on the number of leaves and root fresh weight and significant effect on fresh weight and oven-dry leaves. The highest fresh weight and oven-dry weight was obtained in the interaction of Genie varieties with cow manure, namely 10.06 g and 1.68 g with an increase of 285.44% and 342.10% compared with the interaction of Sigantung varieties with cow manure, namely 2.61 g and 0.38 g. The highest fresh root weight was obtained in the interaction of Genie varieties with cow manure, which was 3.09 g or increased 286.25% compared to interaction between Dewata varieties and cow manure, which was 0.80 g. Genie varieties with cow manure types provide better chili seedling growth compared to Dewata varieties and Sigantung varieties.

**1. Introduction**

Chili is one of the fruit vegetables that has a good business opportunity. Small chili (*Capsicum frutescens* L.) is one of the important vegetable commodities in Indonesian society. This plant is classified as a seasonal plant and for the people of Indonesia is a plant that is very well known as a flavoring agent and a complement to a variety of typical cuisine menus [1]. Chili also contains Lasparaginase and Capsaicin which act as anticancer agents. The nutritional content of cayenne is 103 cal calories; protein 4.7 g; 2.4 g fat, 19.9 g carbohydrates, Calcium 45 mg; phosphorus 85 mg, iron 2.5 mg, Vitamin A 11,050 Si, Vitamin B1 70 mg; Vitamin C 71.2 mg and water 85 g. Spicy taste in chili plants because of capsaicin [2]. The plant nursery is a process of planting seedlings starting from the shape of seeds, the emergence of root buds and several small leaves that are carried out for several days so that it becomes a small plant that is eventually planted for plant growth to maturity and fruiting [3]. Nurseries in chilies play an important role in getting plants that can produce high yields; The better the chili seeds, the better plant growth so that the results obtained are increasing. To get good chili seeds cannot be separated from the variety used and the availability of nutrients at the nursery.

Varieties are groups of plants in certain types or species that can be distinguished from other groups based on certain characteristics. The diversity of plant appearance occurs due to the nature of the plant (genetic) or environmental differences (phenotype) or both. The difference in genetic makeup is one of the factors causing diversity in plant appearance [4]. Varieties play an important role in the development of chili planting cayenne because each variety has different yield potential. Quality varieties (superior
varieties) have one of the hallmarks of local varieties. These advantages can be reflected in its nature that can produce high-yielding fruit, a response to fertilization and resistance to pests and diseases. Varieties that are suitable to the environment are expected to grow well and give high yields [1]. Some chili varieties in Indonesia include TM-99, TM-88, Salero, Taro, Kunthi, CTH-01, Hot Beauty and superior varieties commonly used by farmers, namely: Genie Varieties, Dewata Varieties, Sigantung Varieties, and Gendut Variety.

Fertilization is a very important factor for getting healthy plant growth and being able to produce optimally. Determination of the correct dosage and fertilizing method is needed to create nutrient balance in the soil so that it can be maximally utilized by plants [5]. Manure is an organic fertilizer that has nutrient content that can support soil fertility and microorganisms in the soil. The addition of manure can increase the availability of nutrients, it can also improve soil structure [6]. Manure has natural properties and does not damage the soil. Manure can provide macronutrients (nitrogen, phosphorus, potassium, calcium, and sulfur) and micronutrients (iron, zinc, boron, cobalt, and molybdenum) [6,7]. There are types of animal shed for chicken, cow, goat, rabbit, and others. Manure is a fertilizer that comes from animal waste. Compost derived from chicken manure compared to compost from cow and goat manure provides the best results for chili plants [8]. Likewise, compost derived from rabbit manure has given the best response to chili plants [9]. Application of compost from cow manure [10-13] can increase growth and yield of corn. The treatment of compost from cow manure has a significant effect on fruit length and fresh root weight of red chili plants [14]. Each type of animal produces feces that contain unique nutrients. However, in general, the animal waste contains macronutrients such as nitrogen. The composition of nutrients contained in this fertilizer depends on the origin of the animal species. Age, the base of the cage and feed given to animals also affect the composition of the organic manure produced. (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg) and sulfur (S).

The study aims to determine the effects of giving several types of manures on various chili pepper varieties.

2. Materials and methods

Materials and tools used in this study were chili seeds of Genie, Dewata, Sigantung, and Gendut varieties; chicken manure, cow manure, and rabbit fertilizer; polybags, label paper, stationery, ovens, scales, parents, buckets, sprayers, bamboo, knives, raffia ropes, and documentation tools.

This research was a factorial randomized block design (RBD) with 2 factors tried and in the greenhouse, that lasts from July 2019 until August 2019. The first factor is the variety consisting of 4 levels: V1 = Genie Varieties, V2 = Dewata Varieties, V3 = Sigantung Varieties, V4 = Gendut Varieties. The second factor is the type of fertilizer (R) consists of 3 levels, namely: R1 = Chicken Manure, R2 = Cow Manure, R3 = Rabbit Manure. Thus there were 12 combination treatments and were repeated 4 times so that required 48 polybag experiments. Variables observed: plant height, number of leaves, leaf area, the fresh and oven-dry weight of leaves, stems, and roots.

3. Results

The results of the statistical analysis of all variables obtained the significance of varieties (V) and types of manure (R) and their interactions (VxR) on seedling growth are presented in Table 1.

Base on Table 1, the interaction between varieties and types of manure (VxR) had a very significant effect (P<0.01) on the number of leaves and root fresh weight; significant effect (P <0.05) on the fresh weight and dry oven leaves and no significant effect (P≥0.05) on other variables. Variety (V) treatment significantly affected (P <0.05) on plant height and leaf area and significantly affected (P<0.01) on other variables. While the type of fertilizer had no significant effect (P≥0.05) on all observed variables.
Table 1. The significance of the influence of varieties and types of manure and their interactions on the observed variables.

| Variables                                      | Varieties (V) | Types of manure (R) | Interaction (V×R) |
|------------------------------------------------|--------------|---------------------|------------------|
| 1. Plant height (cm)                           | *            | ns                  | ns               |
| 2. Number of leaves (strands)                  | **           | ns                  | **               |
| 3. Leaf area (cm²)                             | *            | ns                  | ns               |
| 4. Fresh leaf weight (g)                       | **           | ns                  | *                |
| 5. Fresh weight of stem (g)                    | **           | ns                  | ns               |
| 6. Fresh root weight (g)                       | **           | ns                  | ns               |
| 7. Oven dry weight of leaves (g)               | **           | ns                  | *                |
| 8. Oven dry weight of the stem (g)             | **           | ns                  | ns               |
| 9. Oven dry weight root (g)                    | **           | ns                  | ns               |

Note: ns = not significant effect (P≥0.05), * = significantly influential (P<0.05), ** = very significant effect (P˂0.01)

The average growth of chili plants in the treatment of varieties and types of fertilizers is presented in Table 2. From Table 2, it can be seen that the treatment of Genie varieties gives better seed growth in terms of plant height, leaf area, number of leaves, oven-dry weight of roots, stems, and leaves that are higher and significantly different than the varieties Dewata, Sigantung, and Gendut. This is because Genie varieties are chili cultivars suitable for planting in the lowlands to the highlands and able to adapt well.

Table 2. The average growth of chili plants in the treatment of varieties and types of fertilizers

| Treatment                      | Plant height (cm) | Leaf area (cm²) | Fresh weight of the stem (g) | Oven dry weight of the stem (g) | Oven dry weight of the root (g) |
|--------------------------------|-------------------|-----------------|------------------------------|---------------------------------|---------------------------------|
| Varieties                      |                   |                 |                              |                                 |                                 |
| Genie (V1)                     | 51.06 a           | 3025.81 a       | 7.58 a                       | 1.19 a                          | 0.53 a                          |
| Dewata (V2)                    | 45.33 ab          | 2580.79 b       | 4.66 b                       | 0.65 b                          | 0.21 b                          |
| Sigantung (V3)                 | 50.94 a           | 2148.42 b       | 5.28 b                       | 0.72 b                          | 0.26 b                          |
| Gendut (V4)                    | 40.11 b           | 1908.22 b       | 4.69 b                       | 0.62 b                          | 0.29 b                          |
| LSD 5%                         | 7.01              | 608.97          | 1.46                         | 0.21                            | 0.1                             |
| Type of fertilizer             |                   |                 |                              |                                 |                                 |
| Chicken manure (R1)            | 1.00 a            | 2268.02 a       | 5.98 a                       | 0.91 a                          | 0.38 a                          |
| Cow manure (R2)                | 5.17 a            | 2322.93 a       | 5.61 a                       | 0.79 a                          | 0.33 a                          |
| Rabbit manure (R3)             | 4.42 a            | 2656.48 a       | 5.07 a                       | 0.69 a                          | 0.26 a                          |
| LSD 5%                         |                   |                 |                              |                                 |                                 |

Note: The average value followed by the same letter in the same treatment and column, is not significantly different at the LSD test level of 5%.

The results showed that the interaction treatment between Genie varieties with rabbit manure (V1R3) gave the highest number of leaves (Table 3). However, the interaction treatment between Genie varieties and cow manure (V1R2) gave the heaviest leaf weight, root fresh weight, and heavier oven dry leaf weight compared to other interaction treatments (Tables 4, 5, and 6).
Table 3. Average number of leaves in the interaction between varieties with fertilizer types.

| Treatment | Type of fertilizer          |       |       |       |
|-----------|-----------------------------|-------|-------|-------|
|           | Chicken manure (R1)         | Cow manure (R2) | Rabbit manure (R3) |
| Genie (V1)| 25.00 a                     | 26.33 a                           | 28.00 a                  |
|           | A                           | A                                | A                         |
| Dewata (V2)| 23.33 a                    | 23.33 a                           | 14.67 c                   |
|           | A                           | A                                | B                         |
| Sigantung (V3)| 16.33 b                | 17.67 b                           | 19.00 b                   |
|           | A                           | A                                | A                         |
| Gendut (V4)| 16.67 b                    | 15.00 b                           | 17.00 bc                  |
|           | A                           | A                                | A                         |
| LSD 0.05  | 4.01                        |                                  |                           |

Note: The numbers followed by the same lowercase letters in the same column and the same uppercase letters in the same row, did not differ significantly in the 5% LSD test.

Table 4. Average fresh weight of leaves on the interaction of varieties with fertilizer types.

| Treatment | Type of fertilizer          |       |       |       |
|-----------|-----------------------------|-------|-------|-------|
|           | Chicken manure (R1)         | Cow manure (R2) | Rabbit manure (R3) |
| Genie (V1)| 7.59 a                      | 10.06 a                          | 6.91 a                   |
|           | AB                          | A                                | B                         |
| Dewata (V2)| 4.49 a                     | 4.37 bc                           | 3.50 b                    |
|           | A                           | A                                | A                         |
| Sigantung (V3)| 6.83 a               | 2.61 c                            | 6.85 a                   |
|           | A                           | B                                | A                         |
| Gendut (V4)| 6.89 a                    | 6.38 b                            | 3.61 b                   |
|           | A                           | AB                               | B                         |
| LSD 0.05  | 3.12                        |                                  |                           |

Note: The numbers followed by the same lowercase letters in the same column and the same uppercase letters in the same row, did not differ significantly in the 5% LSD test.

Table 5. Average fresh root weights on the interaction of varieties with fertilizer types.

| Treatment | Type of fertilizer          |       |       |       |
|-----------|-----------------------------|-------|-------|-------|
|           | Chicken manure (R1)         | Cow manure (R2) | Rabbit manure (R3) |
| Genie (V1)| 2.56 a                      | 3.29 a                          | 2.52 a                    |
|           | A                           | A                                | A                         |
| Dewata (V2)| 1.39 b                     | 0.80 b                           | 1.06 b                    |
|           | A                           | A                                | A                         |
| Sigantung (V3)| 1.97 ab             | 1.09 b                           | 1.86 ab                   |
|           | A                           | A                                | A                         |
| Gendut (V4)| 2.04 ab                    | 3.09 a                           | 1.00 b                   |
|           | B                           | A                                | C                         |
| LSD 0.05  | 0.97                        |                                  |                           |

Note: The numbers followed by the same lowercase letters in the same column and the same uppercase letters in the same row, did not differ significantly in the 5% LSD test.
Table 6. The average dry weight of leaf oven on the interaction varieties with fertilizer types.

| Treatment  | Type of fertilizer       |               |               |               |
|------------|-------------------------|---------------|---------------|---------------|
|            | Chicken manure (R1)     | Cow manure (R2) | Rabbit manure (R3) |
| Genie (V1) | 1.46 a                  | 1.68 a        | 1.17 a        |
|            | AB                      | A             | B             |
| Dewata (V2)| 0.72 b                  | 0.62 bc       | 0.53 b        |
|            | A                       | A             | A             |
| Sigantung (V3)| 1.13 ab               | 0.38 c     | 1.10 a        |
|            | A                       | B             | A             |
| Gendut (V4)| 1.02 ab                 | 0.97 b       | 0.52 b        |
|            | A                       | A             | A             |
| LSD        | 0.05                    | 0.51          |

Note: The numbers followed by the same lowercase letters in the same column and the same uppercase letters in the same row, did not differ significantly in the 5% LSD test.

4. Discussion
The interaction between varieties and types of manure gives a very significant effect on the number of leaves and fresh weight of roots; a significant effect on the fresh weight and oven-dry leaves. The highest number of leaves obtained in the interaction of Genie varieties with rabbit fertilizer types is 28.00 strands or an increase of 90.86% compared with the interaction of Dewata varieties with rabbit manure types that is 14.67 strands. This is because the Genie variety responds to rabbit manure even though with cow manure the number of leaves obtained is not significantly different at 26.33 strands (Table 3). This is consistent with the results of Wirajaya in testing several types of manure and trimming the apical parts of chili plants obtained rabbit manure gave the highest value compared to other fertilizers [15]. The highest fresh weight and oven-dry leaves were obtained from the interaction of Genie variety treatment with cow manure types, namely 10.06 g and 1.68 g or increased by 285.44% and 342.10% compared to the interaction of Sigantung varieties with cow manure type namely 2.61 g and 0.38 g (Table 4 and 6).

The highest fresh root weight was obtained in the interaction of treatment of Genie varieties with cow manure types, namely 3.29 g. or an increase of 311.25% compared to interaction between Dewata varieties and cow manure types, 0.80 g (Table 5). Good growth of chili seedlings was obtained in the interaction of the treatment of Genie varieties with the type of cow manure which was seen from the high fresh root weight, fresh weight, and oven-dry leaves. This is due to the variety of Genie able to adapt to the environment where it grows and the provision of cow manure types, where cow manure is a cold fertilizer which processes the decomposition slowly by microorganisms so that organic matter decomposes completely and can be absorbed by plants optimally. Cow manure contains nutrients N, P, K, Fe, and other nutrients. Nitrogen is needed for the formation or growth of vegetative parts of plants which can increase the wet weight and oven-dry weight of Geni varieties. Phosphorus is needed in the development of meristem tissue, the growth of young tissues in roots which can increase the fresh weight of roots in Genie varieties. Potassium is very important in the process of plant metabolism and plant photosynthesis so that the overall growth of plant seeds is better [16].

5. Conclusions
The interaction between varieties and types of manure gives a very significant effect on the number of leaves and fresh weight of roots; a significant effect on the fresh weight and oven-dry leaves. The highest fresh weight and oven-dry weight was obtained in the interaction of Genie varieties with cow manure, namely 10.06 g and 1.68 g with an increase of 285.44% and 342.10% compared with the interaction of Sigantung varieties with cow manure, namely 2.61 g and 0.38 g. The highest fresh root weight was obtained in the interaction of Genie varieties with cow manure, which was 3.09 g or increased 286.25%
compared to interaction between Dewata varieties and cow manure, which was 0.80 g. Genie varieties with cow manure types provide better chili seedling growth compared to Dewata varieties and Sigantung varieties.

Acknowledgments
On this occasion, the authors would like to thank the Dean and Head of the Experimental Station of the Faculty of Agriculture, Warmadewa University and friends who have supported this research.

References
[1] Prajnant A 2004 *Agribisnis Cabai Hibrida* (Jakarta: Penebar Swadaya)
[2] Setiadi 2005 *Bertanam Cabai* (Jakarta: Penebar Swadaya)
[3] Syukur M, Sujiprihati S, Yunianti R and Nida K 2010 *J. Agrivigor* **10** 2 148-156
[4] LIPTAN 2000 www.pustaka.litbang.deptan.go.id/agritek.com 10 Maret 2017
[5] Supriyanto 2009 *Zat Pengatur Tumbuh Pupuk Organik Hantu* [Online] Retrieved from http://indonetword.co.id/toko/herbalindo/1316939/Pupuk-Organik-Hantu.htm
[6] Mayadewi A 2007 *Agritrop* **26** 4 153-159
[7] Nasah C 2010 *Peran Mikroba dalam Pertanian Organik Jurusan Hama dan Penyakit Tumbuhan* (Bandung: Fakultas Pertanian, Universitas Padjadjaran)
[8] Situmeang Y P, Sudita I D Y and Suarta M 2018 *International Journal on Advanced Science, Engineering and Information Technology* **9** 6 2088-2095
[9] Wirajaya A A N M, Yuliartini M S and Udayana I G B 2018 *Proceedings of the 1st Warmadewa Research and Development Seminar (WARDS) European Alliance for Innovation (EAI)*
[10] Situmeang Y P, Adnyana I M, Subadiyasa I N N and Merit I N 2015 *International Journal on Advanced Science, Engineering and Information Technology* **5** 6 433-439
[11] Ngongo P M, Situmeang Y P and Kartini L 2018 *SEAS (Sustainable Environment Agricultural Science)* **2** 1 67-71
[12] Situmeang Y P, Adnyana I M, Subadiyasa I N N and Merit I N 2018 *International Journal on Advanced Science, Engineering and Information Technology* **8** 5 2241-2248
[13] Putra I G L A A A, Situmeang Y P, Yuliartini M S and Udayana I G B 2019 *Journal of Physics: Conference Series* **1402** 5 055029
[14] Amaral H D D R, Situmeang Y P and Suarta M 2019 *Journal of Physics: Conference Series* **1402** 3 033057
[15] Wirajaya A A N M, Yuliartini M S and Kartini L 2017 *Pemberian Beberapa Jenis Pupuk Kandang dan Pemangkasan Bagian Apikal Terhadap Pertumbuhan Dan Hasil Tanaman Cabai* (*Capsicum frutescens* L.) (Denpasar: Program Studi Agroteknologi, Fakultas Pertanian Universitas Warmadewa)
[16] Prasetya M E 2014 *J Agrifor.* **8** 2 191-198