

## Conference Paper

# Effect of Mulch on the Growth and Yield of *Polianthes tuberosa*

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## Abstract

Tuberose is one of the most important ornamental plants in Indonesia which the demand continuously increases. However, tuberose is commonly cultivated in drained rice fields and this resulted in various problem such as weed and insect infestation especially mealybug in dry season. In this regard a study was conducted in Malang Regency at Karangploso Experimental Station of East Java Assessment Institute for Agriculture Technology from March 2012 to April 2013. The study employed an experimental method using a randomized block design. Two varieties of tuberoses, *i.e.*, Dian Arum (double flowering) and Roro Anteng (semi-double flowering) were planted on a prepared soil bed. Both tuberose varieties were treated by a silvery plastic mulch cover on one bed and none on the other. Results showed significant differences between the mulch and without mulch treatments in terms of plant growth and flower production. Flower production obtained from mulch treatment was 3.8 stalks/clump or 34.22 stalks/m<sup>2</sup>, whereas that without mulch was 2.47 stalks/clump or 27.44 stalks/m<sup>2</sup>. Meanwhile the damage intensity caused by mealybug infestation on the mulch treatment was 15.21%, while that without mulch was 22.17%. In fact, the use of mulch could reduce the weeding cost up to 66.67% and the total production cost up to 20.86%. The result obtained from R/C ratio analysis with mulch treatment was 2.59 whereas that without mulch was 1.71.

**Keywords:** *Polianthes tuberosa*; mulch; weed, pest; yield; R/C ratio.

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## 1. Introduction

Tuberose (*Polianthes tuberosa*) is one of the most important ornamental plants in Indonesia with the demand continues to increase every year. Although tuberose planting area in Indonesia in the last five years from 2009 to 2013 were unstable *i.e.* 815,709; 623,463; 709,987; 619,355; and 1,134,724 m<sup>2</sup>, respectively, flower and stem productions keep increasing [2]. Despite the respective increases, tuberose farmers still have to face field problems, particularly due to weed and pest attacks. Generally, tuberose is cultivated in the area of drained rice fields which is weekly irrigated in the dry season. This obviously the trigger of a very rapid growth of weeds which

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requires immediate control and more intensive maintenance every 3 to 4 weeks from the beginning of planting until the end of the harvest period for about 2 years after planting. Weeds cause irreparable damage to crops by competing for water, nutrients, light and space, besides acting as alternate hosts to a number of pathogens and insect pests [3]. A manual weed control would be time consuming and takes a lot of labor costs.

Field problems such as mealybug attacks are the considerable problem in the cultivation of tuberose. This pest is widely spread in the production centers of tuberose such as in Cianjur, West Java, and Pasuruan, East Java, and it has caused enormous damage [4, 5]. The attack intensity of this pest has reached 100% damage that led to harvest failures. The high intensity of mealybug attacks begin when the plants are 2 months of age that retain the plants to get into their generative stadium. In fact, mealybugs do not only attack the plants above the ground, but also attacks the tubers in the underground, particularly in dry season.

One of the ways that can be done to overcome these problems is by the use of silvery plastic mulch. According to Barman *et al.* [6] the mulch is the most common and cheapest method for weed control. It can also play a role to control crop pests [7]. However, the use of mulch in tuberose cultivation is still rarely performed and its publications are also limited. Therefore, there is a need to furtherly study the use of mulch in tuberose plants, both from the aspects of cultivation and economic farming analysis. The purpose of this research was to obtain comprehensive information of the effect of mulch on the tuberose growth, costs of weedings, and income of farmers.

## 2. Materials and Methods

The research was conducted in Malang Regency at Karangploso Experimental Station of East Java Assessment Institute for Agriculture Technology (550 m a.s.l.) from March 2012 to April 2013. The experiment employed a randomized block design with four replications. The treatment was a combination of two varieties of tuberoses *i.e.*, Dian Arum (double flowering) and Roro Anteng (semi-double flowering) with and without silvery plastic mulch.

A field of soil was pulverized to a smooth soil mass mixing up with manure to 1 ton/ha, and formed into a plant bed. In accordance with layout of the treatments, a bunch of plastic mulch was fitted on the beds on which numerous holes as appropriate to planting holes at 30 × 30 cm spacings were made. A tuber of tuberose was planted in each hole at a depth of 2 cm below the soil surface.

Before planting, bulbs were sorted based on a predetermined size between of 1 - 1.5 cm. Furthermore, the bulbs were soaked in a solution of insecticide for one night to kill the mealybug pests, so it would not spread over to the field. Once the shoots grow



**Figure 1:** Performance of plant growth with and without mulch.

or 3 weeks after planting ages, the plants were fertilized by 300 kg NPK /ha which were repeated every 6 months, while the manure was reapplied every 3-4 months. The provision of watering and weeding was carried out as needed.

Variables measured include plant growth and the flower yield, vase life, mealy bug damage intensity, economic farming analysis (production costs and R/C ratio). The damage intensity of the mealybug was determined by the formula:

$$I = \frac{\sum(n \times v)}{Z \times N} 100\%$$

where, I = damage intensity; n = scaling value of damage; v = total sample of the same scaling; Z = total of sample; N = highest scaling value. The scaling was based on the population/plant, where 0 = no insect, 1 = 1 – 10, 3 = 11 – 30, 5 = 31 – 50, 7 = 51 – 70, 9 = > 100

### 3. Results and Discussions

#### 3.1. Plant growth

The treatment using mulch cover on the soil bed significantly affect plant growth which was indicated by the growth of plant shoots of both Dian Arum and Roro Anteng varieties. Plant shoots began to appear at the beginning of planting until the end of the vegetative growth (Figure 1 and Table 1). There were 15.86 plant shoots/clump on the mulched bed, while only 6.22 plant shoots/clump on the unmulched bed.

The result indicated that the mulch cover treatment could perform a better growth condition for tuberose. Plastic mulches were useful to provide an adequate plant microclimate for the plants by changing the soil energy balance and reducing evaporation

TABLE 1: Effect of mulch treatment to total plant shoots/clump of Dian Arum and Roro Anteng varieties.

Treatment	Plant age (month after planting)..... (shoot/clump)				
	2	3	4	5	6
1. Dian Arum + mulch	5.45 a	6.46 a	8.78 a	12.82a	15.86 a
2. Dian Arum - mulch	4.31ab	5.76 ab	6.56 ab	8.89 b	10.34 ab
3. Roro Anteng + mulch	2.48 bc	3.77 bc	4.98 ac	6.35 c	8.89 bc
4. Roro Anteng - mulch	1.88 c	3.28 c	3.97 c	4.20 c	6.22 c

from the soil [8]. Due to long growing period the plants requires routine supplies of water though mulch retains soil moisture and sometimes even serves as soil substitutes. It protects the plants from loss of soil moisture caused by wind and soil evaporation and reduces the irrigation requirements [9]. In addition, mulch can prevent and inhibit weed growth, so there is no competition for nutrients between crops and weeds. Mulches help also in controlling weed growth and improving soil structure and fertility [10, 11]. It was also reported that black plastic mulch provided higher percentages of weed control compared to the unmulched soil, *i.e.* 89 and 51%, respectively [12].

### 3.2. The performance of flower and yield

The performance of flowers showed that there was a significant difference between mulch with without mulch in stalk length and diameter of stalk, length and diameter of rachis and number of flower/rachis characters (Table 2). On the other hand, the flower performance including stalk diameter, diameter of flower bud, diameter of flower bloom and vase life were not significantly different between mulch treatments with without mulch treatment.

The highest stalk length was found in mulch treatment *i.e.* 122.27 cm on Roro Anteng and the lowest stalk length was obtained from without mulch treatment *i.e.* 61.82 cm on Dian Arum. Meanwhile, the different between Dian Arum and Roro Anteng variety was more influenced by genetic factors. The highest length of rachis at harvest (48.08 cm) was found from Dian Arum with mulch, and the lowest length of rachis (29.20 cm) was found in Roro Anteng without mulch treatment. The biggest diameter of rachis was found in Dian Arum with mulch (4.47 cm) and the smallest diameter was obtained from Roro Anteng without mulch treatment (2.50 cm). The highest number of flower per rachis (57.38) was found in Dian Arum with mulch, and the lowest number of flower per rachis (42.50) was obtained from Roro Anteng without mulch (Table 2). The same result was reported by Barman et al. [6] which found that mulch treatment produced the better performance in all characters that mentioned above than without mulch treatment.

TABLE 2: Effect of mulch to some characters of flower performance and yield of Dian Arum and Roro Anteng varieties.

Treatment	Flower characters								Flower harvest yield	
	Stalk length (cm)	∅ stalk (cm)	Rachis length (cm)	∅ rachis (cm)	∅ flower bud (cm)	∅ flower bloom (cm)	Number of flower/rachis	Vas life (day)	Number of stalk/clump	Number of stalk/m <sup>2</sup>
1. Dian Arum + mulch	68.89 b	1.17 a	48.08 a	4.47 a	1.18 a	3.57 a	57.38 a	4.70 a	3.08 a	34.22 a
2. Dian Arum – mulch	61.84 b	1.13 a	29.81 c	3.58 ab	1.15 a	3.25 a	46.60 b	4.90 a	2.79 b	31.00 b
3. Roro Anteng + mulch	121.32 a	1.14 a	34.88 b	3.04 ab	1.10 a	3.36 a	47.30 b	4.60 a	2.91 ab	32.33 ab
4. Roro Anteng – mulch	103.44 a	1.11 a	29.20 c	2.50 c	1.05 a	3.21 a	42.50 c	4.20 a	2.47 b	27.44 c

The flower harvest yield showed that there was a significant difference between treatment in number of stalks per clump and per meter. The highest flower harvest yield (3.08 stalk/clump or 34.22 stalk/m<sup>2</sup>) was found in Dian Arum with mulch, and the lowest flower harvest yield (2.47 stalks/clump or 27.44 stalk/m<sup>2</sup>) was obtained from Roro Anteng without mulch (Table 2). It appears that silver plastic mulch might have induced favorable conditions conducive to attainment of flowers with the better performance and higher harvest yield. The same result was reported by Barman et al. [6] that mulch treatment performed the better yield harvest of tuberose than without mulch.

### 3.3. Damage intensity of mealybug

Mealybug pest attacks were found during the course of the study, especially in the dry season. Results – as also similarly proven that mulch cover significantly affect the intensity of pest attacks to both plant varieties (Figure 2). It showed that the highest damage intensity of mealybug attacks (22.17%) was found in the unmulched soil bed of Roro Anteng and the lowest damage intensity (15.21%) was obtained from the mulched soil bed of Dian Arum. This result indicated that the mulch has caused unfavorable condition to mealybug growth, so the population declined, and eventually the plant protected from more severe damage.

The similar case was reported by Summers *et al.* [6] who stated that mulches significantly reduced aphid occurrence as opposed to bare soil. Silver leaf whitefly numbers, both adults and nymphs, were accordingly reduced by plastic mulch which were significantly lower than with bare soil. According to Iyengar *et al.* [11], silvery black

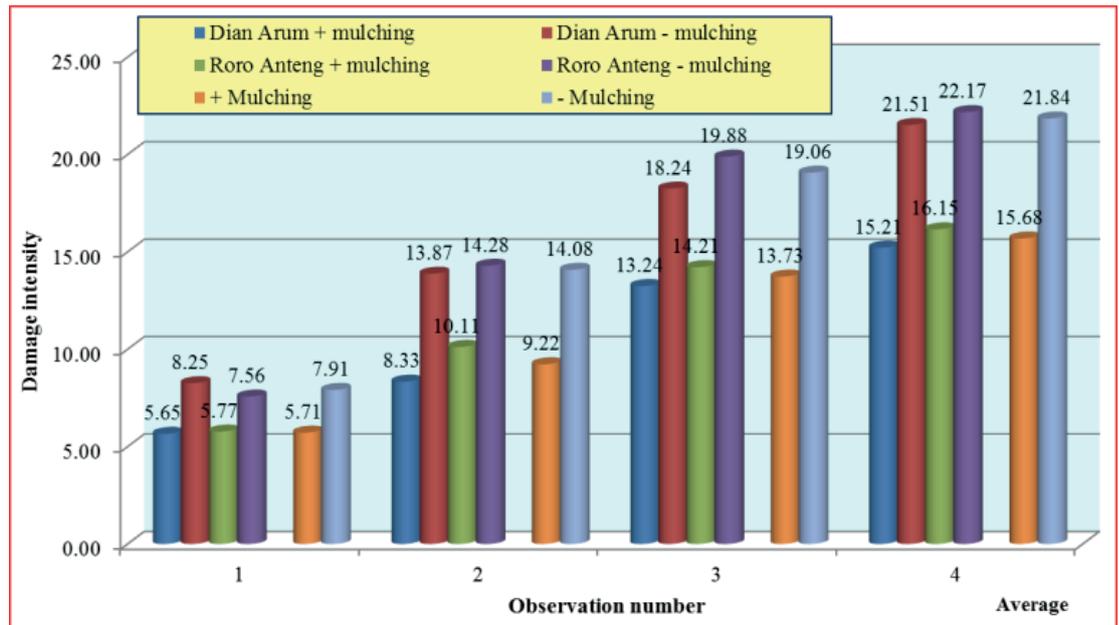


Figure 2: Effect of mulch to damage intensity of mealybug.

mulch can more reflect ultraviolet ray, which repel some insects and pests, such as aphids, thrips and whiteflies. The same condition was also suspected occurred in this study, leading to the conclusion that the use of plastic mulch could reduce the rate of mealybug population growth. In addition, mulch would keep maintaining soil moisture, not drying and cracking, especially during the peak of the dry season. So mealybug could not attack the plant bulbs.

### 3.4. Economic farming analysis

The economic farming analysis as shown in Table 3 indicated that the use of mulch had reduced the cost of weeding up to 66.67% than without mulch. Although there was more expenditure for plastic mulch treatment, but it was still lower than the labor costs for weeding in the unmulched treatment. This result was similar to that in India and India spent about 70-80 per cent of cultivation costs accounts only for weeding [12].

In this study, the revenue in the mulch treatment (Table 3) was Rp 9,975,000, while with without mulch Rp 8,765,000. Although the profit only Rp1,210,00 but the cost incurred in the mulch treatment 20.86% lower than without mulch. Economic farming analysis also indicated that the R/C ratio on mulch treatment (2.59) was greater than without mulch treatment (1.71). Thus the use of mulch in tuberose cultivation was more profitable than without mulch. Considering the better plant growth and flower production and the lower production costs and the higher profits, then the silvery plastic mulch was recommended for use in the tuberose cultivation.

TABLE 3: Farming analysis of mulch treatment on Dian Arum and Roro Anteng variety (land area about 1000 m<sup>2</sup>).

Description	Mulching	Without mulching
- Costs	3.846.875	5.128.000
1. Labour (land processing, bedding, planting, maintenance, harvesting @ Rp 50.000/person/day)	2.550.000	4.550.000
2. Production facilities (plastic mulch, seed, manure, pesticide)	1.296.875	578.000
- Revenue (yield: mulching 19.650 stalk; without mulching 17.530 stalk), price @ Rp 500/stalk	9.975.000	8.765.000
- Benefit	6.128.125	3.637.000
- R/C ratio	<b>2,59</b>	<b>1,71</b>

## 4. Conclusions

1. Mulch treatment give the better plant shoot growth, flower performance in some characters namely stalk length and diameter of stalk, length and diameter of rachis and number of flower/rachis; and yield harvest of tuberose than without mulch treatment on both Dian Arum and Roro Anteng varieties
2. Mulch treatment also declined the damage intensity of the mealy bug by only 15.21%, compared to without mulch by 22.17%.
3. The use of mulch could reduce the weeding cost up to 66.67% and the total production cost 20.86% compared to without mulch.
4. R/C ratio on mulch treatment was 2.59, while without mulch was only 1.67, thus the use of mulch in tuberose cultivation was more profitable and applicable.

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