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Re-utilization Suboptimal Planting Media to Cultivate Black Rice in the Pot

Pemanfaatan Kembali Media Bekas Tanam Suboptimal untuk Budidaya Tanaman Padi Beras Hitam Menggunakan Pot

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ABSTRAK

Disamping untuk mengurangi biaya produksi, pemanfaatan media suboptimal bekas tanam merupakan praktek budidaya yang baik. Penelitian ini bertujuan untuk mempelajari kemungkinan penggunaan kembali media suboptimal bekas tanaman untuk budidaya padi beras hitam. Penelitian dilakukan dengan menggunakan pot ukuran 10 kg yang disusun menurut pola Rancangan Acak Kelompok, meliputi 3 ulangan, masing-masing terdiri dari 5 pot. Perlakuannya berupa persentase penambahan bahan organik berupa tanah organik lokal dan pupuk organik komersial yaitu 5%, 10%, dan 15%, serta tanpa penambahan (0%). Hasil penelitian ini menunjukkan bahwa dengan penambahan 10% tanah organik lokal, tanamannya dapat tumbuh mencapai tinggi 150 cm, memiliki 70 anakan, dan menghasilkan 56,52 g gabah kering per pot, yang setara dengan 11,69 ton/ha. Peningkatan penambahan tanah organik lokal dari 5, 10 dan 15%, meningkatkan beberapa variabel produksi per rumpun, masing-masing 33−53% untuk jumlah malai matang; 33−56% untuk jumlah gabah total; 123−232% untuk jumlah gabah bernas; dan 106−289% untuk berat gabah kering. Penelitian ini menyimpulkan bahwa praktek pemanfaatan kembali media bekas tanam dapat dilakukan dengan penambahan bahan organik dan semakin banyak bahan organik yang ditambahkan, secara umum meningkatkan pertumbuhan dan produksinya.

Kata kunci: media-tanam-bekas, padi-beras-hitam, pemanfaan, pot

ABSTRACT

Besides reducing production cost, re-utilization suboptimal planting media was environmentally good practice, especially when the plants were cultivated in the pots. This research was carried out to to find out the possibility of re-utilization of suboptimal used media to cultivate black rice in the pots. In this research, the plants were cultivated in 10 kg pots, arranged in Randomized Block Design with three replications, each consisting of 5 pots. The treatments were weight-based additions of local organic soil and commercial organic fertilizer of 5%, 10%, 15%, and 0% (no-addition). The results showed that the plants with addition of 10% local organic soil, were observed to grow normally with plant

height reaching 150 cm, consisting of 70 clumps and producing 56.52 g dry seeds per pot, equivalent to 11.69 tons/ha. In percentage, the addition of 5, 10, and 15 % local organic soil resulted in a 33−53% increase in the number of mature panicles, 33−56 % increase in the total number of seeds, 123−232% increase in number pithy seeds, and 106−289 % increase in weight of dry seeds per pot. This research finally concluded that re-utilization of suboptimal used-media was possible with addition of organic material, and more addition, in general, resulted in the increase on growth and yield of the plants.

Keywords: black-rice, pot, re-utilization, used-media

INTRODUCTION

As an effort to solve the problem in land limitation, farmers and other agriculture practicals apply the technique to grow plants in the pot. This technique becomes more popular, along with the increase in people's interest in agriculture. Since, application of this technique required additional cost to buy pots, the popularity, at first, was to cultivate high economic fruit plants, that called "Tabulampot" as an abbreviation for "growing fruit plants in the pot" Saputra (2021). Recently, many farmers have also used this technique in rice cultivation (Figure 1).

Black rice cultivation in the pots has a good prospect because black rice has a higher economic value than regular rice. This economic value derived from the benefit of consuming black rice to maintain health and body fitness. Pratiwi (2022) reported that Tokopedia offered commercial black rice grain at the price of 35 to 50 thousand rupiahs per kg, about 3 to 5 times the price of premium regular rice. Concerning the benefit to maintaining health and body fitness, Zhang et al. (2012) and Pedro et al. (2016) reported that black rice has higher anthocyanin content than regular rice. Kristamtini et al. (2018) reported that anthocyanin content on black rice varied depending on color variation of the seed. For that reason, many researchers stated that consuming black rice was good to prevent several human health problems such as, high blood-pressure, and high sugar and cholesterol content (Sompong et al., 2012; Zhang et al., 2012) Furthermore, research by Hernawan and Meylani (2016) reported that black rice also contained high fiber of 5.8 to 7.8% higher than regular rice with a fiber content of 2.3 to 5.4%. Concerning the current situation of pandemic Covid-19, Sastro (2020) stated that Indonesian Rice Research Institute has introduced tblack rice variety of "Jaliteng", with high content of vitamin E and Zinc that benefit to maintain immunity.

Indonesia has various rice cultivars, including black rice, as rice is considered a staple food (Kristianti, 2012). The black rice cultivars, however, have low productivity and quality with high broken-grains of about 25% as compared to imported black rice (Haryadi, 2015). For this matter, the research program at Department Agronomy, Faculty of Agriculture, Universitas Sriwijaya, reported and released 4 (four) black rice accessions that are potential to be new cultivars with high productivity and high grain quality called as Unsri-P1, Unsri-P2, Unsri-P3, and Unsri-P4 (Halimi et al., 2018 and Halimi, 2020). These black rice accessions, even more, have been crossed with Inpara 5 variety by Cahyani (2018), and their progenies were evaluated by Hidayat (2019), Octavia (2020), Ronasyary (2021) and Pratiwi (2022).

As stated above, plant cultivation method by using pot requires additional cost to buy pots. Other than that, such method requires better and nutrient-rich media, and consequently, continuous black rice cultivation in the pots also requires an efficient and friendly-environment way in the provision of the media. This research was been carried out, with the main objective to find out the possibility of re-utilization of used-media to cultivate black rice in the pots.

MATERIALS AND METHODS

This research was carried out in an open farm-land area at experimental station, Faculty of Agriculture, Kampus Unsri Indralaya, South Sumatra, Indonesia, from January to May 2019 by using 10 kg/pots. Research utilized black rice accession of Unsri-P3 resulted from pedigree selection method on "Purwokerto" cultivar (Halimi et al., 2018 and Halimi, 2020). In this research, a single plant of 15-days old seedlings was planted in each pot. The used-media that was re-utilized in this research (Figure 1) was taken from previous black rice research by Syakirin (2018).

This used-media was considered suboptimal with a low fertility level as showed in Table 1. The media was prepared and mixed with local organic soil and commercial organic media (Figure 1). Before mixing, the used-media was crushed and cleaned free from un-decomposed materials. Furthermore, as recommended by previous research (Syakirin, 2018 and Pales, 2019), each pot was fertilized two times with 15 g urea, 15 g SP-36, and 15 g KCl during planting and at 60 days after planting. Each pot was also fertilized two times with 2.0 g silica granule, at 30 and 60 days after planting. During a period of research, the pots were maintained free from weeds with a consistent water level at 3 to 6 cm from the soil surface, and drained by the time of harvesting.

The treatment on this research consisted of several level of additions (w/w) of local and commercial organic material as follows: P0 = Used-media without any addition of organic materials; P1, P2, and P3 = Used media with addition of 5%, 10%, and 15% local organic materials, respectively; P4, P5, and P6 = Used media with addition of 5%, 10%, and 15% commercial organic materials, respectively. The research was designed as Randomized Block Design, with 3 blocks, each consisting of 5 pots (total 105 pots). Statistical analysis was performed by using Analysis of variance (ANOVA) followed by Fisher's protected LSD test at $\alpha = 0.05$ (Gomez & Gomez, 2015) and the calculation was done by using computer application of Statistical Analysis System (SAS-Institute, 2020).

Evaluation on the plant growth and yield was done by measuring some variables of plant height and tiller number per pot at 4, 6, 8, and 10 weeks after planting; total panicles number and total mature panicles (with seeds maturity > 85%) per pot; total number, dry-weight of seeds per pot, and dry-weight of 100 seeds (Table 2).

Table 1. Result of laboratory analysis on the used-media, local organic soil, and commercial organic media utilized in the research

Analysis Component	Unit	Used-Media and Source of Organic Materials		
		Used-Media (*)	Local Organic Soil (*)	Commercial Media (**)
N	%	0.29	0.32	1.50
P_2O_5	%	0.41	0.31	0.90
K_2O	%	0.22	0.34	1.90
pH	-	6.31	6.26	6.50

Note: (*) Laboratory of PT. Sucofindo, Palembang sampel number: 02634/CLAKAM and 02635/CLAKAM, 17 July 2019. (**) Leaf let of Improbio ™ product 2019.

Figure 1. Research materials of used-media (a), local organic soil (b), and commercial organic media (c), pots and planting preparation for the research (d), plants condition at 40 days (e) and 100 days (f) after planting), and example of rice cultivation by farmer in the pot (g) and in the polybag (h).

Tabel 2. F-values and coefficient of variation (CC) resulted from the Analysis of Variance (Anova) on several variables measured on the research

No.	Variables	F-Value	CC (%)
a.	Growth Variables		
1	Plant Height at 4 Weeks After Planting	1.52^{ns}	8.15
2	Plant Height at 6 Weeks After Planting	1.18^{ns}	12.11
3	Plant Height at 8 Weeks After Planting	5.62^{*}	9.72
4	Plant Height at 10 Weeks After Planting	6.62^{*}	6.29
5	Tiller Number at 4 Weeks After Planting Per Pot	3.15^{*}	7.85
6	Tiller Number at 6 Weeks After Planting Per Pot	7.55^{*}	9.47
7	Tiller Number at 8 Weeks After Planting Per Pot	10.98^{*}	7.94
8	Tiller Number at 4 Weeks After Planting Per Pot	3.84^{*}	10.07
b.	Yield Variables		
1	Total Number of Panicles Per Pot	7.30^{*}	19.95
2	Number of Mature Panicles Per Pot	1.05^{ns}	13.12
3	Total Number of Seeds Per Pot	17.93^{*}	17.85
4	Number of Pithy Seeds Per Pot	14.59^{*}	11.77
5	Number of Empty Seeds Per Pot	3.40^{*}	12.28
6	Dry-Weight of Seeds Per Pot	14.79^{*}	19.35

Note: * = Statistically different and, ns = not statistically different at $\alpha = 0.05$.

RESULTS AND DISCUSSION

Results of statistical analysis by using Anova on several growths and yield variables were shown in Table 2. Further analysis by using Fisher's protected LSD at $\alpha = 0.05$ was shown in Figure 3. The result of this research, in general, indicated that re-utilization of used-media was possible to cultivate black rice in the pots. As revealed by the Analysis of variance (Table 2), almost all variables measured were statistically significant with F-values of 3.15 to 10.98. This analysis was considered valid and accurate for agricultural research with the coefficient of variations < 20% (Gomez & Gomez, 2015).

Growth variables measured on the research were plant height and tillers number at 4, 6, 8, 10 weeks after planting (Figure 2). The plants' height was about 60 to 70; 84 to 92; 138 to 149, and 139 to 154 cm; respectively with 14 to 22; 22 to 43; 50 to 69; and 64 to 73 number of tillers per pot, respectively. Analysis of variance (Table 2) on growth variables indicated significant, except, for plants height measured at 4 and 6 weeks after planting that could be related to the general phenomenon of the slow growth of many plants that usually occurred at the early stage of growth. At 8 to 10 weeks after planting, the plant height began to differentiate, in which, most plants cultivated with the addition of local organic soil (P1, P2, and P3), grew significantly higher than plants cultivated with no-addition of organic materials (P0). Different results, however, were obtained on tiller number measurement that has shown significantly different since 4 weeks after planting, at 4 and 6 weeks observations, plants cultivated with additions 10 % (P5) and 15 % (P6) of commercial organic matter tended to have more tiller number than others, although at 8 weeks observation all plants cultivated with additions of organic material, either local or commercial (P1 to P6) grew better with more tiller number of 69−72 per pot, as compared to the plants cultivated with no-addition of any organic material (P0) with 64 tiller number per pot (Figure 2).

The growth of black rice accession used in this research seemed to produce more tillers earlier that to increase plant height. In rice research, measurements on plant height and tiller number were done, indeed, to estimate growth relative, in which, plants having higher plant height and more tiller

number were usually considered to have better growth. For that reason, results of this research suggested that re-utilization of used and suboptimal media is possible to cultivate black rice by using pot and along with the addition of organic materials, in general, will result in better plant growth. As stated by Utomo (2016), this is simply related to the more availability of nutrients, and better texture, and structure of media resulting from the addition of organic materials to the media. Yield variables to be measured in this research consisted of the number of total panicles and number of mature panicles per pot; total number and dry-weight of 100 seeds per pot. Measurement of mature panicles was determined based on the proportion of mature seeds in the panicles that have reached > 85%.

This variable was first, introduced by Halimi et al. (2018) as an attributed character for grain quality, in which the greater values might indicate higher-quality rice product with a lower proportion of broken grain. As shown in Figure 3. The results of this research indicated that plants cultivated with the addition of local organic soil (P1, P2, P3) had 20 to 23 mature panicles per pot, higher than plants cultivated with no-organic materials addition (15 panicles per pot).

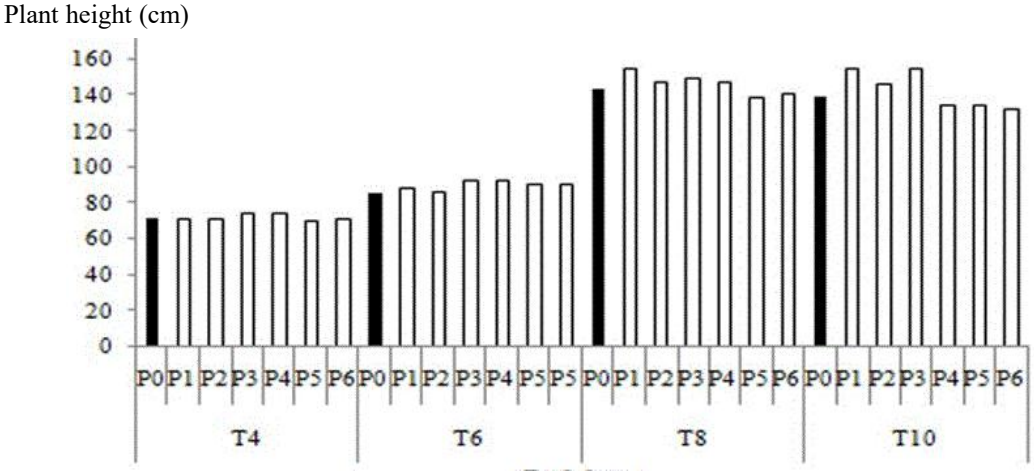
Eventually, P1, P2, and P3 plants had a significantly higher number of mature panicles compared to plants cultivated with the addition of commercial organic media (P4, P5, and P6) with several mature panicles 9 to 14 panicles per pot. Lower mature panicles in most plants cultivated with no addition (P0) and with the addition of commercial organic materials (P4, P5, P6) suspected due to the condition of those media that had higher water content during the harvesting period as suggested by (Susanti et al., 2020).

Lestari (2019), stated that visual observation during the period of harvesting (15−16 weeks after planting), indicated that respected media, indeed, still looked damp, wet, and watery, even though, the water drained from the pots. This condition was assumed to be related to the raw materials in the commercial organic materials that according to the product specification to have the higher water-holding capacity (water retention).

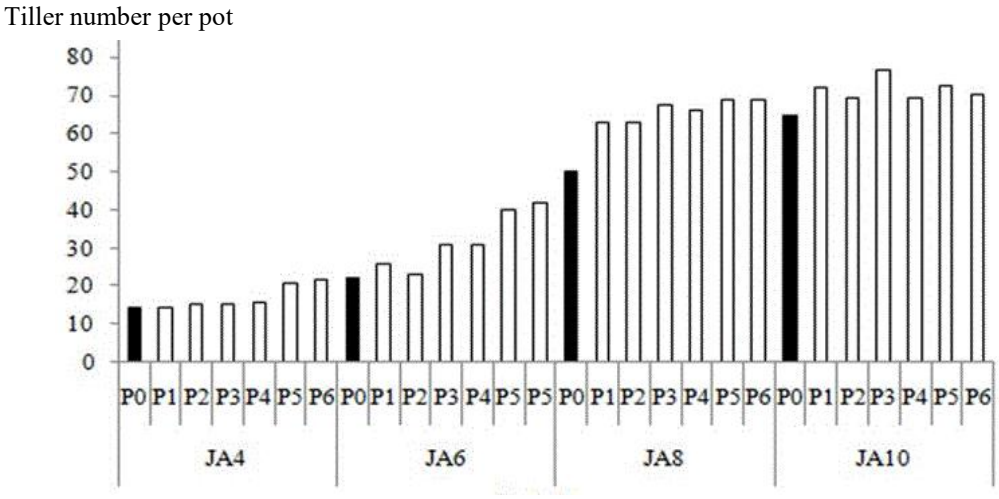
Based on this novelty, this research suggested that to have better yield, re-utilization of suboptimal used-media to cultivate black rice by using the pot, should consider the water-holding capacity of the organic material added into the media. Furthermore, measurements and analysis on other yield variables (Figure 3), showed a similar pattern that plants cultivated with the addition of local organic soil (P1-P3) were likely to have more total number of seeds, number and dry-weight of pithy seeds (Figure 3), each about 4328 to 5067 and 1972 and 2940 seeds, and 25.7− to 8.7 g seeds per pot, higher than plants cultivated with no-addition of organic materials (P0) that only reached 3246 and 883 seeds per pot, with 12.5 g dry-weight seeds per pot.

In percentage, increase in the value of the variable measured were about 33 to 53% for the number of mature panicles, 33 to 56% for the total number of seeds, 123 to 232% for the number of pithy seeds, and 106 to 289% for dry-weight of seeds per pot (Table 3). Assuming a population density of 160.000 pot per ha with planted space of 25 cm x 25 cm (Susanti et al., 2020), the potential yield of the black rice accession cultivated with the additional local organic materials (P1, P2, P3) could reach 9.04-14.39 ton dry seeds per ha.

This potential yield was higher than the average potential yield of respected accession reported by Halimi et el. (2018) that reached 8.81-ton dry seeds per ha. Eventually, this potential yield, indeed, is higher than the black rice variety of "**Jaliteng"**, released in 2019, which reached a potential yield of 9.87-ton dry seeds per ha (Sastro, 2020).



(a)



(b)

Figure 2. Plant height (a) at 4 (T4), 6 (T6), 8 (T8) and 10 (T10) weeks after planting and tiller number (b) at 4 (JA4); 6 (JA6); 8 (JA8), and 10 (JA10) weeks after planting of black rice cultivated in the pot by using used and suboptimal media with addition of 5 %, 10% and 15% of local organic soil (P1,P2,P3) and commercial organic media (P4,P5, P6) respectively.

Table 3. Percentage in the increase on several yield variables of black rice plants cultivated in the used-media with addition of local organic soil of 5% (P1), 10% (P2), and 15% (P3) as compared to the plants cultivated with no-addition of organic materials (PO).

Variables	P1	P2	P3	P0
Percent increase in total number of seeds per pot	33.3% (4 329)	48.12% (4 808)	56.13% (5 068)	- (3246)
Percent increase in number of pithy seeds per pot.	123.44% (1 973)	218.69% (2 814)	232.96% (2 940)	- (883)
Percent increase in dry-weight of pithy seeds gram per pot	106.08% (25.76)	42.40% (42.80)	89.68% (48.71)	- (12.50)
Percent increase in yield potential (dry-weight of seeds, gram per pot).	3.00% (56.52)	59.12% (73.120	82.74% (83.97)	- (45.95)
Percent increase in percentage of mature panicles per pot,	45.66% (22)	33.33% (20)	53.33% (23)	- (15)

Note: Number in the brackets are the real number of each respective variables.

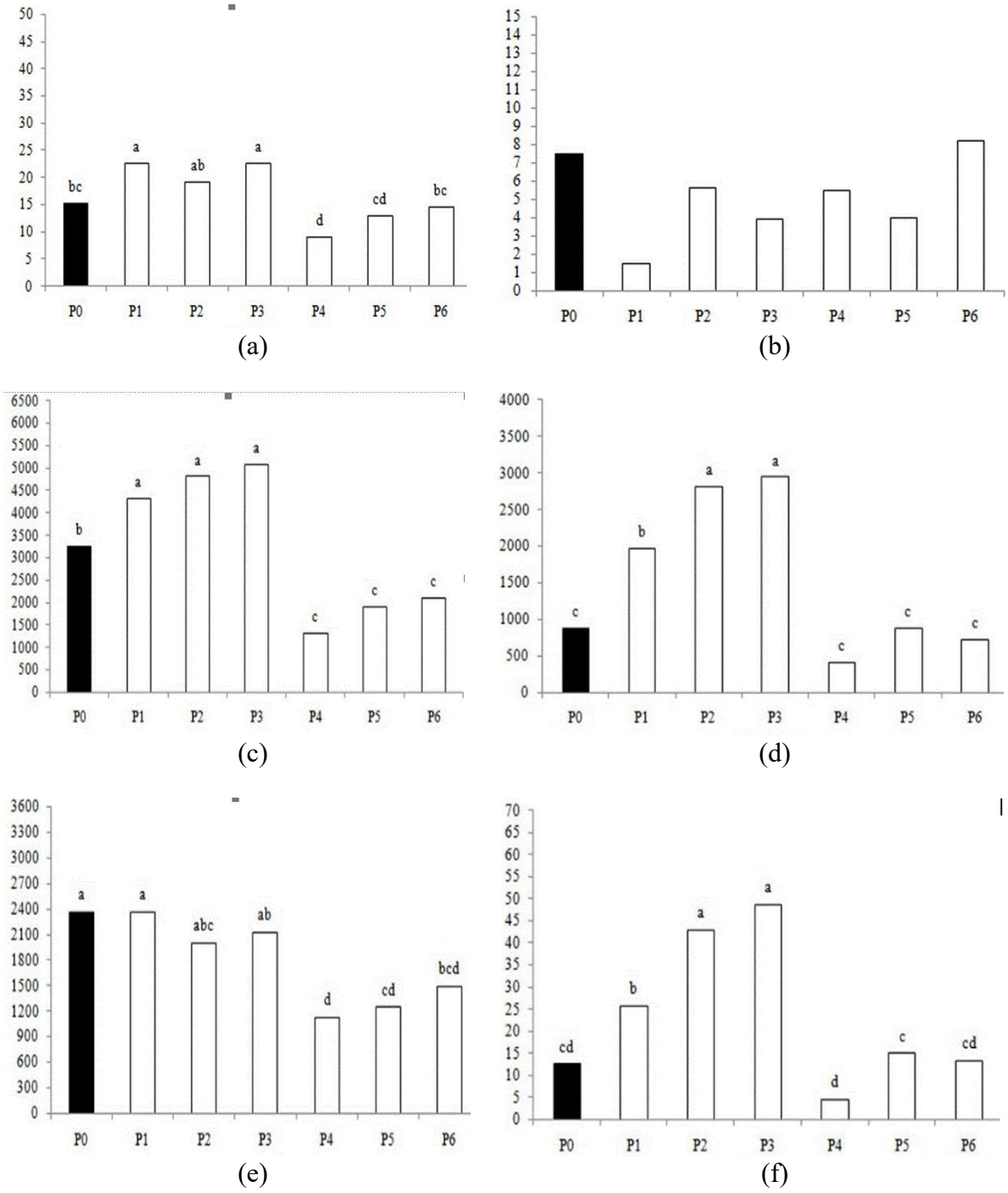


Figure 3. Number of mature (a), and immature (b) panicles; total number of seeds (c), number of pithy seeds (d) number of empty seeds (e) and dry-weight of pithy seeds (f) per pot of black rice cultivated in the pot with by using used-media with no-addition of organic materials (P0), with addition 5 %, 10 % and 15 % of local organic soil (P1, P2, P3) and commercial organic media (P4,P5,P6) respectively. (Bar with the same letter indicated not significantly different according to the Fisher's protected LSD test at α=0.05).

CONCLUSSION

In general, this research concluded that reutilizing suboptimal used media to cultivate black rice using pot was possible with added organic materials. More added organic materials might result in better plant growth and higher yield. Moreover, this research suggested that 10 % addition of local organic soil was enough to have good growth and high yield, with a plant height of 150 cm, 70 tillers, and seed dry-weight reached 56.53 g/pot, equivalent to 11.69 ton dry seeds per ha. In percentage, increasing 5, 10, and 15% addition of local organic soil to the used media, might result in 33 to 53% increase in number of mature panicles, 33 to 56% increase in the total number of seeds, 123 to 232% of the number of pithy seed, and 106 to 289% increase in dry-weight of seeds per pot.

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