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Rice Seeds Coated with N-Enriched Organomineral Fertilizer Joko Priyono a* and Anak Agung Ketut Sudharmawan b a

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,

5**Indonesia.** **Authors' contributions This work was carried out in collaboration between** both **authors. Author** JP **designed the study**, technical aspects **of** seed coating, constructs **the** outline **and** wrote **the**

13**first draft of the** manuscripts. **Author** AAKS performed **the** statistical analysis **and** managed **the literature searches** for seed treatments. **Both**

1**authors read and approved the final manuscript.** **Article Information DOI: 10.9734**/ARJA/**2022**/v15i4366 **Open Peer Review History: This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history**/92976 **Received** 13 August **2022 Original Research Article Accepted** 18 October **2022 Published** 20 October **2022**

ABSTRACT

Seed coating with silicate rock-basis organomineral fertilizer (OMF) was proposed

2**as an appropriate method to improve the productivity and profitability of**

rice farming. This research aimed to evaluate

2**the growth and yield components of** rice **grown**

from coated seeds with N-enriched OMF. The coated seeds of two rice varieties, i.e., Trisakti (T) and Nutri Zinc (NZ) were tested in separate experimental sets. A randomized block design was applied for each experiment with the treatment consisting of non-coated seed (NCS), coated seeds containing 4.5% N (CS-1), 7.8% N (CS-2), and 9.0% N (CS-3) in 3 blocks. The coating material of OMF was a mixture of 90% basaltic rock and 10% rock phosphate, enriched with N accordingly to the treatment; and the weight ratio of seed to OMF was about 1:16. The coated seeds were planted directly to the ground (without sowing and transplanting steps), and only NCS was fertilized with NPK (15:15:15) equivalent to 300 kg. ha-1. Results reveal that there was no significant difference in growth components (number of tillers and the weight of top-biomass) and quality of rice grains (weight of 1,000 grains) for the plants of coated and non-coated seeds. Enriching OMF with N up to 9% consistently improved the total yield of rice. Therefore, seed coating with OMF containing about 9% N was an appropriate method to optimize rice yield.

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*Corresponding author: E-mail: jokotanahunram@gmail.com; Keywords: Organomineral fertilizer; coating materials; seed coating; silicate rock fertilizer. 1. INTRODUCTION Seed industries have applied seed coating technology for decades aimed mainly

9**to improve** the **productivity and profitability of farming**. Most of **the**

seed coatings, however, were designed to protect the seeds from the attack of soil-borne pathogens [1]. Consequently, the used coating materials contained various pesticides including fungicides and rodenticides [2,3,4], with supplementary plant nutrients [5], or zeolite [6]. Because exposing toxic pesticides to farming land can develop pest resistance and create various negative-ecological effects, the use of synthetic pesticides as the seed coating material should be avoided [7]. This is a major challenge for seed industries to develop coated seeds with more environmentally friendly materials. Referring to the above case, we developed the coated seed of rice with local abundance and environmentally friendly materials, which was silicate rock-based-organomineral fertilizer (OMF), by applying different approach. Improving the

9**productivity and profitability of farming was** not by protecting **the seeds**

or plants from the attack of pests and pathogens, but by maximizing the healthiness and

7**resistance of plants to biotic and abiotic stresses**

using OMF. Practically, the plants were supplied with proportional essential and functional (Si) nutrients in form of OMF. The components of OMF were mainly the finely ground basaltic and some phosphatic rocks, enriched with nitrogen substances. The OMF was designed as the main source of all plant- essential nutrients to support the optimum plant growth and yield and supply a functional nutrient of silicate (Si) to maximize

7**the resistance of plants to biotic and abiotic stresses**

[8,9,10] without additional fertilizer. In addition, the OMF may also act as a remediating agent for disordered plant-growing media such as acidic [11] or salt-affected [12] soils. Rice is a non-legume plant requiring a large amount of nitrogen (N) for optimum growth [13]. On the other hand, enriching the coating material with a high concentration of N fertilizers (e.g., urea) may create a technical problem in the coating process. It was because covering the seeds with materials containing a high concentration of N may toxify and stop the coated seed germination. In addition, the thickness of coated material may limit oxygen availability for the seed-embryonic tissue [14] delaying the germination process. Thus, the appropriate concentration of N as well as the thickness and suitable procedure of coating process must be found. Results of a greenhouse assessment for the performance of the coated seeds of rice with OMF [15] showed that adding N to the coating material up to 2.5% was not sufficient to gain optimum growth and yield. Following up on that finding, this present research was intended to find out an appropriate method of adding enough N to the coating material (OMF), so that the plants from the coated seeds grow and yield optimally without additional N fertilizer.

19**The main objective of this research was to**

find out the most suitable amount of N added to the coating material (OMF), by evaluating the growth and yield components of the OMF-coated seeds compared to those of the non-coated seeds.

16**2. MATERIALS AND METHODS 2.1** Coating **Materials** and Process **The** coating material **of**

10%), and stored in a closed container. Before planting, the produced coated seeds were tested for their germination rate in a growth chamber. Results of the test confirmed that the coated seeds used in this research were very good – germinated > 95%. 2.2 Experimental Setting The experiment was conducted on an irrigated paddy soil classified as Oxyaquic Hapluderts in Keruak Village - Central Lombok Regency, Indonesia. The soil was clay textured (46% clay), having a low content of total C-organic (1.2%) and total N (0.02%); the Olsen-extractable P2O5 was 16 mg. kg-1, the acidity was about neutral (pH 7.2); the cation exchange capacity of the soil was 36.2

12**cmol. kg- 1, and** the **exchangeable K, Ca, Mg, and Na** respectively were **0**

.14, 32.4, 4.4, and 0.1 cmol. kg-1. The agronomic performances of the coated seeds of each variety were tested in separate experimental sets. A randomized block design was laid out for each experimental set with the treatment consisting of non-coated seed (NCS), CS-1, CS-2, and CS-3 in 3 blocks. The size of an experimental unit (plot) was 5 m x 5 m, and between plots were separated by a 50-cm borderline. The soil was mechanically cultivated by plugging, mudding, smoothing, and allowed to equilibrate for two days in a saturated condition. The seeds were planted directly onto the saturated ground without germination or transplanting steps. Five seeds were planted per planting point

4**with a spacing of 25 cm** x 25 **cm. The**

water level in each plot was maintained at 1 – 5 cm over the soil surface accordingly to the growing stage of the plants. Only the non-NCS plants were fertilized with NPK (

8**15:15:15) at the rate** equivalent to **300 kg. ha**-1. Harvesting **was**

done 110 days after planting.

2**2.3 Data and** Statistical Analyses **The main** collected data (**parameters) were the**

number of productive tillers, the weight of top-dry biomass, and whole and 1,000 grains. The analysis of variance (ANOVA) was carried out for each set of data, and the parameters significantly affected by the treatment were further evaluated with

8**the least significant difference (LSD) method**

at

4**α = 0.05. 3. RESULTS AND DISCUSSION 3.1** The **Growth Components The**

number of productive tillers per hill and the weight of top-dry biomass were presented in Table 2. In addition, it was observed that the coated seeds germinated 3 – 5 days later than the non-coated ones; and there was no indication of N-deficient symptoms of plant leaf (data are not shown in this paper). Statistically, there were no significant differences in growth performance (number of productive tillers and weight of dry-top biomass) between rice plants from the non-coated and coated seeds, either for the Trisakti or Nutri Zinc varieties. As shown in Table 2, the number of productive tellers per plot was about 35, and the weight of dry-top biomass per plot was about 17.5 kg. Based on the plant growth data, it may be interpreted that

17**the effect of seed** coating **with** OMF **on the growth** components **of** rice was similar to that for the application of synthetic fertilizer (NPK 300 kg. ha-1). Table 2. The number (mean ± Sdev) of tillers and weight of top-dry biomass for Trisakti and Nutri Zinc Varieties Type of Seeds Number of Productive Tillers per Hill*) Top-Dry Biomass (kg.plot-1) Trisakti Nutri Zinc Trisakti Nutri Zinc NCS (34.3 + 1.2) (34.3 + 1.0) (17.7 + 0.5) (17.8 + 1.5) CS-1 (36.1 + 0.5) (34.6 + 1.0) (18.0 + 0.4) (18.2 + 0.4) CS-2 (35.1 + 1.0) (34.7 + 0.7) (18.6 + 0.7) (18.8 + 0.4) CS-3 (37.6 + 1.1) (34.9 + 0.7) (18.7 + 0.4) (19.4 + 0.3) *) Average values from 20-randomly sub-sampled plant hills Table 3. The weights (mean ± Sdev) of whole and 1,000 grains for Trisakti and Nutri Zinc Varieties Type of Seeds Weight of Whole Grains Weight of 1,000 Grains (kg. plot-1)*) (g) Trisakti Nutri Zinc Trisakti Nutri Zinc NCS (14.42 + 1.56) a (14.22 + 1.28) a (28.59 + 0.71) (26.83 + 0.62) CS-1 (13.72 + 0.70) a (14.17 + 0.76) a (28.17 + 0.85) (26.91 + 1.01) CS-2 (15.74 + 0.37) b (15.38 + 0.33) ab (26.03 + 1.34) (27.09 + 0.67) CS-3 (16.52 + 0.48) c (16.73 + 0.64) b (28.52 + 0.96) (26.52 + 0.96) LSDα=0.05 0.77 1.28 - - *) The values

6**followed by the same letters are not significantly different**

based on the analysis of LSDα=0.05 3.2 Yield Components The yield components, i.e., the weights of whole grains per plot of 25 m2 and 1,000 grains, were presented in Table 3.

6**Results of analysis of variance showed that the** quantity **of**

rice yield for non-coated

15**seeds was significantly different from that** for **the** coated **seeds, but**

there was no significant effect of the different types of seeds on the quality of rice grain (weight of 1,000 grains). As shown in that Table 3, the rice yields were consistently improved by the increases of N concentration in the coating material OMF; and the highest yields were gained by the plants of CS-3, which were about 16.6 kg. plot-1 (equivalent to 6,640 kg. ha-1). Based on the results, coating the rice seeds with OMF containing about 9% N was a suitable method to optimize production. 4. CONCLUSION The growth components (number of tillers and weight of biomass) and grain quality (weight of 1,000 grains) of the rice plants grown from the non-coated seeds were similar to those for the coated seeds with the N-enriched OMF. On the other hand, adding N up to 9% to the coating material (OMF) improved the grain yield of rice plants from the coated seeds, and the seed coating method was a suitable method to optimize production. By planting the OMF-coated seeds, farmers may gain optimum yield without applying additional fertilizers.

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14**COMPETING INTERESTS Authors have declared that no competing interests exist**

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