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RESEARCH ARTICLE
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Enhancing Salinity Tolerance in 18 Local Rice Varieties from West Kalimantan through Biopriming with Biological Agents

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ABSTRACT

Saline land has the potential for developing rice plants in Indonesia. High salt content causes a decrease in water availability for plants, damages leaves, and limits nutrient absorption. The use of biological agents is expected to increase the growth and yield of rice plants on saline land. This study aimed to evaluate the response of 18 local rice genotypes from West Kalimantan, Indonesia, to biopriming with a biological agent (WH3.1C isolate) under salinity stress. The experiment was conducted in two phases: the germination and seedling growth stages. A Randomized Block Design (RBD) was employed, with salinity levels as the main plot treatments (0 ppm, 4000 ppm NaCl, and 4000 ppm NaCl + WH3.1C isolate) and rice genotypes as subplots. The 18 genotypes comprised 10 black rice, 3 red rice, and 5 white rice varieties. The results of the research showed that genotypes of local rice showed different growth responses to 4000ppm NaCl. Application of WH3.1C isolate to water culture media that had previously been subjected to 4000ppm NaCl gave growth of rice that was not different from rice that were not subjected to salinity stress. The percentage of wet weight of root Banyuwangi Merah and Gula Hitam seedlings increased after being treated with the WH31.C isolate. Black Sugar rice also showed a percentage increase in root dry weight. This was suggested that WH3.1C isolate had capability to minimize the impact of salinity on the 18 local rice seedlings tested.

Keywords: Functional Microbes; Germination; Invigoration; Lokal Rice; NaCl Stress

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INTRODUCTION

Local rice varieties are increasingly under threat due to limited sustainable management, utilization, and conservation efforts. If this trend continues, it may lead to the large-scale extinction of these genetically diverse resources. Despite their vulnerability, local rice cultivars represent a valuable genetic reservoir with both current and future potential for crop improvement. The advantage of local rice is that it is able to adapt to various environmental stress conditions (drought, salinity, low light intensity and low temperature) for years or even centuries. Rice produced by local rice plants has stable yields, low input, small and elongated grain shape, and a distinctive taste and aroma so that it is very popular with farmers and consumers. The superior characteristics of local rice are very important in improving varieties for current and future generations. Utilization of local rice as a genetic resource is very necessary to deal with environmental changes, fulfill consumer tastes, and reserve genetic resources for plant breeders who are useful in gene donors for variety improvement. The use of adaptive local rice plants is very important to support productivity and food crop production, especially in West Kalimantan (Purwestri et al., 2023).

West Kalimantan has various genotypes of local rice which produce white, red and black rice. This local rice has resistance to environmental stress that has not been published. Several genotypes of local rice in West Kalimantan can be tested for their resistance to salinity stress using the biopriming technique on seeds using biological agents. Seed biopriming has attracted much attention due to its potential to induce seed germination, and provide initial support for seedling growth under stress conditions (Fiodor et al., 2023). The addition of biological agents through the biopriming technique can help local rice

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grow well even in stressful environmental conditions. Seed biopriming is an effective technology to encourage rapid and uniform seed emergence and achieve high vigor, resulting in better stands and crop yields. Seed biopriming is a new approach to inoculate seeds with microbes to promote plant-microbe interactions (Zaher et al., 2022). Biopriming causes an increase in ATP synthesis, which promotes selective absorption and defense mechanisms in plants (Chakraborti et al., 2021).

One good test method for selection is using a 4000ppm salt solution in soil media (Sulaiman, 1980), and testing using the nutrient solution method with 4000ppm NaCl is quite good for testing initial selection of rice tolerance to salinity (Suhartini & Zulchi, 2017). Testing can be carried out in the germination phase and the seedling phase. Testing during the germination and seedling phases is an easy and fast way to determine the tolerance of rice plants to stress. Considering the long lifespan of local West Kalimantan rice, namely 6-7 months. Several types of biological agents are reported to be used in seed biopriming promotion of germination, the promotion of growth after germination, the induction of resistance against biotic and abiotic stresses, and as environmentally friendly biostimulants, such as: bacterial isolates 4A in rice seeds (Herawati et al., 2021); Hadi et al. (2021), use of N-fixing rhizobia, P-solubilizing bacteria, and Indole Acetic Acid (IAA) producers in rice seeds; *Bacillus paralicheniformis* in tomato seeds (Parinith et al., 2022); bacterial isolate SH-8 in wheat seeds and SH-6 isolate in corn seeds (Shaffique et al., 2022, 2023); bacterial isolate SE21 in porang seeds (Palupi et al., 2024); and rhizobacteria on rice seeds in salin soils (Palupi et al., 2025).

Hamdayanty et al., (2022), implementing plant growth promoting rhizobacteria (PGPR) can be an alternative to increasing rice production. Therefore, in this study, biopriming was carried out integrated with biological agents on 18 local rice plants from West Kalimantan, Indonesia which were subjected to salinity. The novelty of this research is the use of biopriming techniques on rice seeds using biological agents to increase seed viability and vigor, as well as increase the growth of rice seedlings under salinity stress conditions. The use of biological agents was obtained from exploration of specific local West Kalimantan peatlands. A total of 18 genotypes of local rice were obtained from several areas in West Kalimantan, Indonesia.

This research aims to determine the response of 18 local rice plants from West Kalimantan, Indonesia that were given biopriming using biological agents on seed viability and vigor, as well as the growth of rice seedlings under salinity stress conditions.

MATERIALS & METHODS

This research was conducted from May to October 2024 at the following locations within the Faculty of Agriculture, Tanjungpura University, Pontianak, Indonesia: (1) the Plant Pest and Disease Laboratory, (2) the Agronomy and Climatology Laboratory, and (3) the Faculty's experimental field site. The materials used include seeds of 18 types of local rice from West Kalimantan, namely local black rice (Gula, ITAM, ITAMP, Ketan Pulot, Kudit, Langsit, Padi Gunung, Raras, Saricatn, and Tuba Pasak); red rice (Merawat, Ringka, and Sirendah); and white rice (Banjar, Banyuwangi, Dangkan, Ketumbar, and Mayang Kelapa). The biological agent used for biopriming is isolate WH3.1C, which was isolated from peatland used to plant corn in Wajok Hilir village, West Kalimantan, Indonesia. This isolate has the ability to bind N, dissolve P and K, and produce Indole compounds (IAA) (Sinambela, 2019). Salinity stress uses NaCl with a concentration of 4000ppm. Planting media uses straw paper and AB-Mix solution. This equipment includes seedling trays, meters, pH meters, thermos-hygrometers, scales, analytical balances, ovens, sprayers and other supporting equipment.

This research consisted of two testing stages, namely the germination and seedling phases. The design used in this research was a Randomized Block Design. The main plot is the salinity level consisting of: 0ppm, 4000ppm, and 4000ppm + biological agents (WH3.1C isolate). The subplot is local rice genotypes, consisting of 18 genotypes. Each treatment combination was repeated 3 times with 20 sample plants tested at the germination phase and 10 sample plants at the nursery phase. NaCl stress of 4000ppm (4g NaCl/L equivalent to EC 6mS/cm) was given when soaking the seeds. Biopriming of rice seeds used WH3.1C isolate suspension with a density of 10^9 per cfu/mL. Soaking the seeds in the first experiment was carried out for 24 hours using an aerator to provide oxygen to the seeds (Halimursyadah et al., 2015). Next, the seeds are sown in a germination medium consisting of sterile soil, manure and rice husk charcoal. Watering is done twice a day.

After the seedlings were 14 days old, they were transferred to the test media in the second experiment (nursery phase). The planting media in the second experiment was an AB-Mix solution, which was divided into 3 treatments, namely (1) AB-Mix, (2) AB-Mix + 4000ppm NaCl, (3) AB-Mix + 4000ppm NaCl + WH3.1C isolate. The salinity stress in the second experiment was carried out gradually to avoid osmotic shocks. The first stage of giving NaCl is 2000ppm NaCl at 14 days after planting, then after 1 week it is increased to 4000ppm NaCl.

The variables observed in the salinity resistance test at the germination phase consisted of:

1. Vigor Index (%), assessed based on the percentage of normal sprouts that appear on the first count. Vigor index calculated by the formula:

$$\text{Vigor Index} = \frac{= \text{ Total of normal sprouts at the first count}}{\text{Total seeds observed}} \text{ x } 100\%$$

2. Germination Percentage (%), calculated based on percentage normal sprouts first count and the second count, with the formula:

$$\text{Germination Percentage}=\frac{\text{Total of normal sprouts at the first count+second count}}{\text{Total seeds observed}} x\ 100\%$$

Calculate the vigor index and germination percentage by the formula Sadjad et al. (1999). Vigor index testing and seed germination percentage were carried out on the first count (7th day) and the second count (14th day) after sowing.

3. Plumule Length (cm), was observed at 14 days after sowing, starting from the base of the plumule to tip of the plumule.

4. Radicle Length (cm), was observed at 14 days after sowing by measuring the primary roots from the base to the tip of the root.

The variables observed in the salinity resistance test at the seedling phase consisted of:

1. Seedling Height (cm), was measured on the 6th week after transplanting. Measurements start from the base of the stem to growing point.
2. Root Length (cm), was measured on the 6th week after transplanting. Measurements start from the base of the stem to the longest root.
3. Percentage Decrease in Wet Weight and Dry Weight of Roots of Seedlings (%), calculated by formula:

$$\text{Percentage Decrease} = \frac{\text{final value (4000ppm NaCl)} - \text{initial value (0ppm NaCl) x 100}}{\text{initial value (0ppm NaCl)}} x\ 100\%$$

4. Percentage Increase in Wet Weight and Dry Weight of Top of Seedlings (%),

$$\text{Percentage Increase} = \frac{\text{initial value (4000ppm NaCl)} + \text{final value (4000ppm+WH3.1C)}}{\text{initial value (4000ppm NaCl)}} x100\%$$

The average temperature during the study was 27.9℃, with a maximum temperature of 35.7℃, and a minimum of 23.0℃. Meanwhile the average humidity is 81%, with a maximum humidity of 90%, and a minimum humidity of 75%.

Data were analyzed using Analysis of Variance (ANOVA) at a 95% confidence level. Significant differences between two treatments were analyzed with Duncan's Multiple Range Test (DMRT) (Gomez & Gomez, 1995) using Statistical Analysis System (SAS).

RESULTS & DISCUSSION

Germination Performance of 18 Local Rice Genotypes from West Kalimantan under Salinity Stress Following Biopriming with Biological Agents

The results of biopriming experiments using biological agents on the viability and vigor of 18 local rice seeds that experienced salinity stress showed a significant interaction effect on the vigor index and plumule length but no significant effect on germination percentage and radicle length. The significant effect of the genotypes was only seen in germination percentage. The results of the DMRT test for vigor index and plumule length can be seen in Table 1 and Fig. 1, while the germination percentage can be seen in Table 2.

Table 1 shows that the vigor index of the 18 types of local rice tested, both in the 0ppm NaCl and in the 4000ppm NaCl treatment, did not have a significantly different effect. The vigor index value between 0ppm treatments when compared with that treated with 4000ppm NaCl, tended to be higher. Meanwhile, in the NaCl 4000ppm + isolate WH3.1C treatment, there were differences in response between 18 local rice plants. The vigor index value of the NaCl 4000ppm + isolate WH3.1C treatment also tended to increase compared to those treated with salinity stress 4000ppm NaCl. The highest vigor index was found in ITAM local rice (98.33%), significantly different from ITAMP local rice (56.67%).

Table 1: DMRT test results on the Vigor Index of 18 local rice seeds from West Kalimantan which were given biopriming using WH3.1C isolate under salinity stress conditions

Local rice genotypes	Level of salinity stress (ppm)		
	0	4000	4000 + WH31.C isolate
Banjar	63.33ab	68.33ab	65.00ab
Banyuwangi Merah	90.00ab	91.67ab	93.33ab
Dangkan	90.00ab	80.00ab	86.67ab
Gula Hitam	91.67ab	78.33ab	83.33ab
ITAM	93.33ab	75.00ab	98.33a
ITAMP	93.33ab	75.00ab	56.67b
Ketan Pulot	90.00ab	68.33ab	86.67ab
Ketumbar	95.00ab	78.33ab	90.00ab
Kudit Hitam	91.67ab	73.33ab	81.67ab
Langsit Hitam	88.33ab	80.00ab	93.33ab
Mayang Kelapa	88.33ab	85.00ab	90.00ab
Merawat Merah	81.67ab	85.00ab	95.00ab
Padi Gunung	93.33ab	81.67ab	88.33ab
Raras Hitam	93.33ab	75.00ab	81.67ab
Ringka	85.00ab	65.00ab	91.67ab
Saricatn Hitam	95.00ab	75.00ab	88.33ab
Sirendah Merah	73.33ab	78.33ab	91.67ab
Tuba Pasak	98.33a	75.00ab	93.33ab

Numbers followed by the same letter in each column and row are not significantly different at the DMRT test level with α = 5%

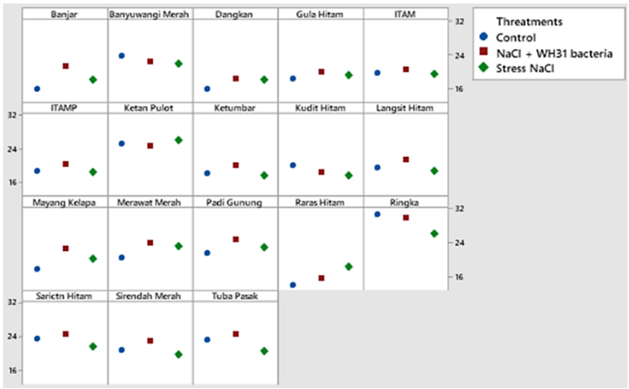

Fig. 1: Plumule length of 18 local rice seeds that were given biopriming using WH3.1C isolate under salinity stress of 4000ppm.

The plumule length of 18 local rice from West Kalimantan that received biopriming treatment using biological agents under 4000ppm NaCl stress conditions tended to show undisturbed growth. In almost all local rice genotypes tested, the length of the sprout plumule in the 4000ppm NaCl + isolate WH3.1C treatment was not different compared to the 0ppm NaCl treatment. Ringka rice had the highest plumule length in all treatments given (Fig. 1).

Table 2 shows that the germination percentage of 18 local rice plants tested by applying 4000ppm NaCl + isolate WH3.1C produced no different germination percentages, except for Banjar rice, which produced a low germination percentage of 75%, different from Gula Hitam and Merawat Merah rice. The 4000ppm NaCl + isolate WH3.1C stress given in this study did not have a detrimental effect on rice seed germination on 17 other local rice plants tested. This can be seen from the germination percentage which is still very high (ranging between 80.56-92.78%). The response of rice plants to salinity varies according to their growth stage. This means that giving rhizobacteria to 17 local rice seeds that experienced salinity stress was able to overcome the saline stress conditions so that rice germination was not disturbed.

Table 2: DMRT test results on effect genotypes to germination percentage of 18 local rice seeds from West Kalimantan which were given biopriming using WH3.1C isolate under salinity stress conditions

Local rice genotypes	Germination Percentage
Banjar	75.00^{b}
Banyuwangi Merah	87.78^{ab}
Dangkan	88.33^{ab}
Gula Hitam	92.78^{a}
ITAM	87.78^{ab}
ITAMP	86.11^{ab}
Ketan Pulot	88.33^{ab}
Ketumbar	88.89^{ab}
Kudit Hitam	89.44^{ab}
Langsit Hitam	87.22^{ab}
Mayang Kelapa	88.33^{ab}
Merawat Merah	92.22^{a}
Padi Gunung	90.00^{ab}
Raras Hitam	86.11^{ab}
Ringka	80.56^{ab}
Saricatn Hitam	83.33^{ab}
Sirendah Merah	81.67^{ab}
Tuba Pasak	90.56^{ab}

Numbers followed by the same letter in each column are not significantly different at the DMRT test level with α = 5%

The WH3.1C biological agent used in biopriming can increase the viability and vigor of rice seeds. This can be seen from the germination percentage and seed vigor index values. This isolate has the ability to bind N, dissolve P and K, and producing Indole compounds (IAA) (Sinambela, 2019). Sapsirisopa et al. (2009) reported that soaking rice seeds with suspension

Bacillus megaterium A12ag is capable increases seed germination and yield rice harvest under salinity stress. Palupi et al. (2017), reported that seed treatment using *P. diminuta A6* and *B. subtillis 5/B* was able to increase seed vigor when germinating, and could also influence the germination percentage of rice seeds. Rhizosphere bacterial isolates IAA producers have a positive effect significant for seed germination rice on the parameters of total sprout length and rice sprout vigor index (Sutrisno, 2021).

Seeds that are soaked in a solution of biological agents will experience controlled water imbibition so that water containing biological agents enters the seeds slowly until balance occurs. This process allows seeds to optimize their internal factors to initiate germination, such as restoring membrane integrity, because seeds that have experienced stress have their membranes damaged. This process includes changes in physiological and biochemical activities in the seed. Ruliyansyah, (2012) mentioned several types of enzymes related to membrane repair such as ATPase, ACC deaminase and isocitrate lyase whose concentrations increased during biopriming treatment. One of the indirect actions by biological agents is to increase plant growth through increasing tolerance to abiotic stress (Grover et al., 2021). The biological agent isolate WH3.1C is thought to have strong ACC deaminase activity and IAA hormone synthesis. Biopriming of seeds by several IAA-producing bacteria has been reported to have a positive effect on seed germination. Corn seeds soaked in a bacterial suspension from producer IAA resulted in a 27% increase in germination (Hagaggi & Mohamed, 2020).

Seedling Performance of 18 Local Rice Genotypes from West Kalimantan under Salinity Stress Following Biopriming with Biological Agents

The results of the experiment on the effect of biopriming on the growth of seedlings of several local rice plants from West Kalimantan that were stressed by salinity showed that the interaction between biopriming using WH3.1C isolate and 18 local rice seedlings had a significant effect on plant height, root length, percentage decrease and increase in wet weight and dry weight of roots and shoot of seedlings. Plant height and root length can be seen in Fig. 2, 3, 4, and 5.

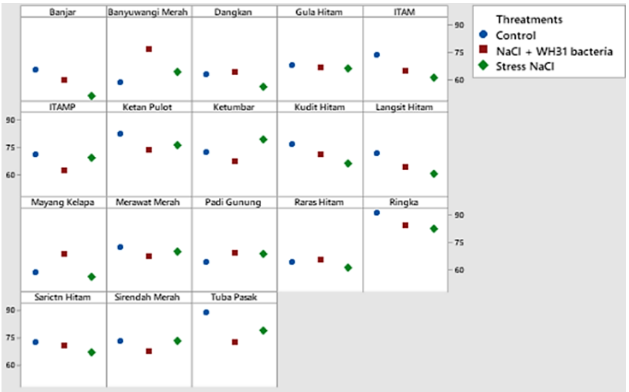

Fig. 2: Comparison of seedling height of 18 local rice treated with biopriming using WH3.1C isolate under salinity stress of 4000 ppm.

The results of plant height analysis of the 18 types of local rice tested showed that the highest plant height was produced by Ringka rice, namely 91.83cm in the treatment 0ppm NaCl, which was significantly different from Mayang Kelapa rice (58.3cm), Dangkan (55.9cm), and Banjar (50.8cm) in the 4000ppm NaCl treatment. Although the responses of the 18 local rice types that were stressed with 4000ppm NaCl did not differ significantly, when compared with the treatment 0ppm NaCl, the height of the plants in the 4000ppm NaCl treatment trended to be lower, ranging from 50.87 to 82.8cm. High salinity causes physiological and biochemical disturbances in rice plants and is influenced by osmotic stress and ionic stress (Carillo et al., 2011). Ghosh et al. (2016) reported that salinity causes a decrease in several plant parameters, one of them is plant height.

In the NaCl 4000ppm NaCl + isolat WH3.1C treatment, the given of biological agents to the 18 local rice tested was able to eliminate the effect of salinity stress. This can be seen from the height of the seedlings values which do not differ between the 18 local rice. The application of biological agents via biopriming to seeds was able to restore the effects of salinity stress on 18 genotypes of local rice tested. This is proven by the seedlings height value in the 4000ppm NaCl + isolat WH3.1C treatment which is not significantly different from the without stress. The seedlings height values in the 4000ppm NaCl + isolat WH3.1C treatment ranged from 59.60cm (Banjar) to 84.70cm (Ringka). The height of the seedlings of the 18 of rice tested can be seen in Fig. 3.

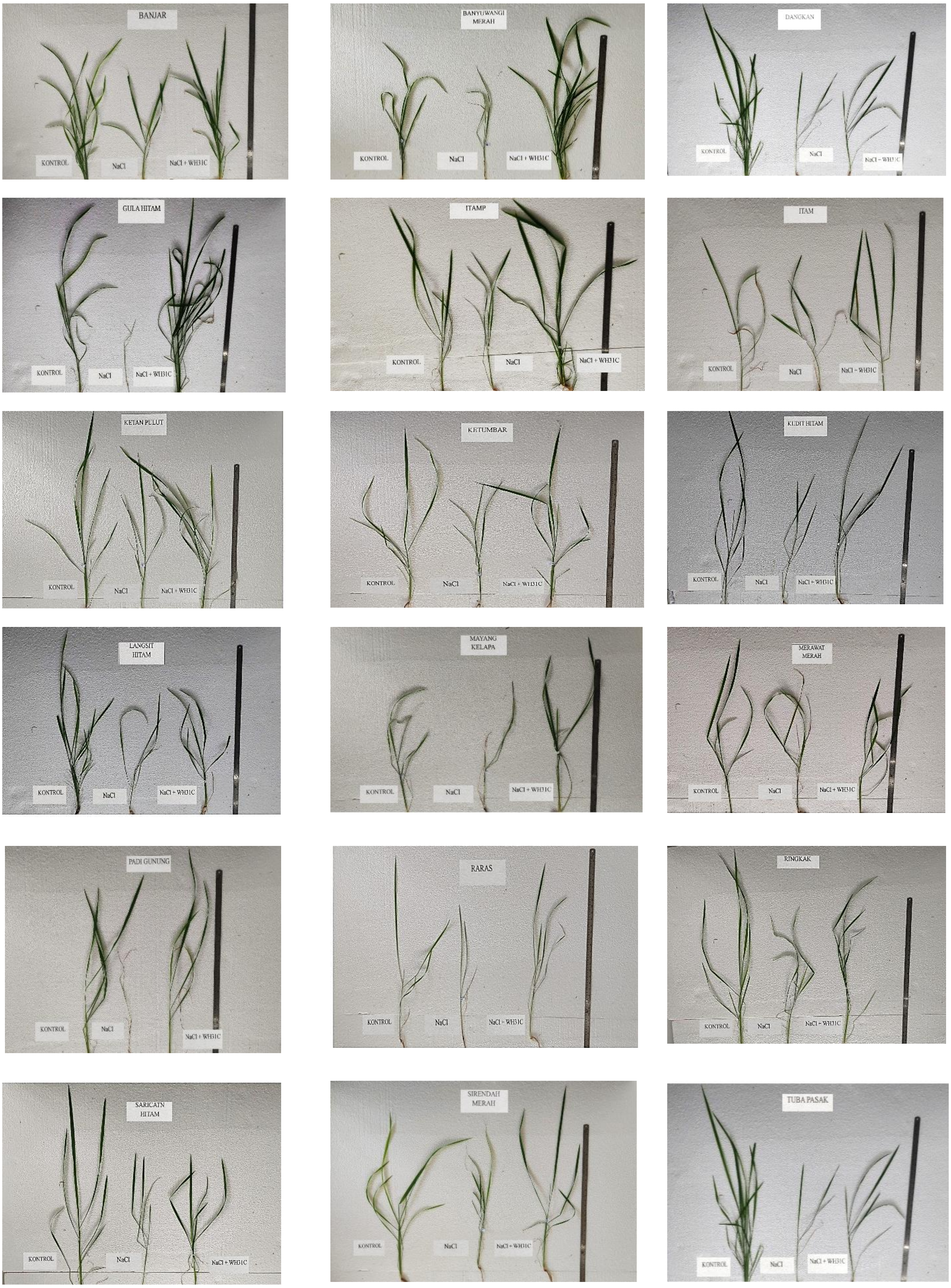

Fig. 3: Seedlings height of 18 local rice that were given biopriming using WH3.1C isolate under salinity stress conditions with NaCl of 4000ppm.

This situation in line with the research results of Rustikawati et al. (2014), that treatment 4000ppm NaCl in nutrient culture media causes a significant reduction in the height of rice seedlings. According to Romadloni & Wicaksono (2018), the decreasing growth in seedlings height is caused by osmotic stress which makes it difficult for plants to absorb water as well as the influence of excessive Na and Cl ions. The effect of giving NaCl also causes cell division and enlargement to be inhibited. This matter in accordance with the opinion of Hutajulu et al.

(2013), that the influence of excess salt on rice plants is a reduction in seedlings height. The role of biological agents in minimizing the effects of salinity was also reported by Palupi et al. (2024), WH3.1C bacteria are the microbes with the best function to increase rice growth and production. Palupi et al. (2025) also reported that rhizobacteria given to seeds before planting in soil experiencing salinity stress were able to minimize the impact of salinity on the soil.

Fig. 4 shows that under the 0 ppm NaCl treatment, there were no significant differences in root length among the 18 local rice genotypes. Root lengths under non-saline conditions ranged from 15.13cm in *Banyuwangi Merah* to 22.37cm in *Saricatn Hitam*. The same thing happened to the root length of rice seedlings under 4000ppm NaCl treatment, there was no significant difference in effect between the 18 local rice plants tested. The length of the roots ranges from 22.30cm (Banjar) to 31.80cm (ITAM black rice). The length of rice roots stressed by 4000ppm NaCl tended to be longer than the treatment 0ppm NaCl, especially in Ketumbar, Banyuwangi Merah and ITAM rice. In the treatment 0ppm, the root length of Ketumbar rice was 17.03cm, while in the 4000ppm NaCl treatment the root length was 29.10cm. Banyuwangi Merah rice in the 0ppm NaCl treatment had root length of 15.13cm, while in the 4000ppm NaCl treatment the root length was 29.27cm. Likewise with ITAM black rice, in the 0ppm NaCl treatment the root length was 20.50cm, while in the 4000ppm NaCl treatment the root length was 31.80cm. The root length of rice seedlings in the 400ppm NaCl + isolate WH3.1C treatment showed an effect that was not significantly different among the 18 local rice plants. The length of rice roots subjected to 4000ppm NaCl + isolate WH3.1C ranged from 23.93 (Padi Gunung and Langsit Hitam), to 34.87cm (Banyuwangi Merah). The application of 4000ppm NaCl + isolate WH3.1C showed a significantly different response when compared to the 0ppm NaCl, but was not significantly different when compared to the 4000ppm NaCl treatment. This can be seen in the root length of Sirendah Merah rice which was 17.80cm in the 0ppm NaCl treatment, while in the 4000ppm NaCl + isolate WH3.1C treatment it was 30.70cm; Banyuwangi Merah was 15.13cm in the 0ppm NaCl treatment, while in the 4000ppm NaCl + isolate WH3.1C treatment it was 34.87cm; and Mayang Kelapa was 16.30cm in the 0ppm NaCl treatment, while in 4000ppm NaCl + isolate WH3.1C it was 27.83cm. An interesting thing happened in Ketumbar rice, where the giving of biological agents could eliminate the effect of salinity stress on the root length of the seedlings, so that the root length was not significantly different from that produced in the 0ppm treatment.

The increasing root length in several genotypes of rice tested is thought to be the result of the plant's mechanism for dealing with the stress it faces. Salinity stress causes some rice plants to experience drought due to high NaCl concentrations outside the plant tissue. The roots of rice plants try to find water by extending their roots deeper. Plants that experience stress due to lack of water usually tend to elongate their roots to obtain the water the plant needs, this is a form of plant adaptation. The same thing was confirmed by Wijayanti et al., (2014), that salinity stress can affect the agronomic properties of peanuts. In general, saline environments reduce rice growth. Salinity causes physiological disturbances. Salinity will decrease plant biomass production due to inhibited absorption water and minerals for plants (Gian et al., 2021). The addition of salt to the soil makes it difficult for the roots to absorb nutrients due to its presence competition. The competition that occurs is that plants experience ion stress due to their height Na^+ content in cells. High Na^+ content makes it difficult for roots to absorb nutrients such as N and P (Fahmi et al., 2023). Plant responses to salinity stress are primarily determined by the level of stress experienced and the growth phase when experiencing stress (Seran & Raharjo, 2018). Eighteen local rice plants tested had different advantages in dealing with salinity stress. The different advantages in growth characteristics displayed by rice types are due to different genetic capabilities (Nurahmadi et al., 2019).

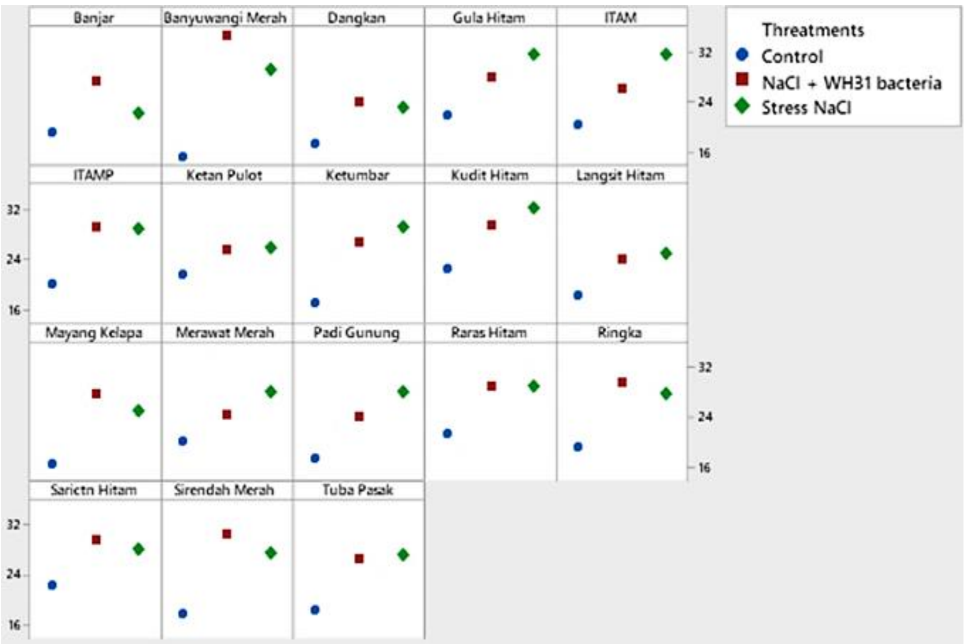

Fig. 4: Comparison of root length of 18 local rice that were given biopriming using WH3.1C isolate under salinity stress conditions with NaCl of 4000ppm.

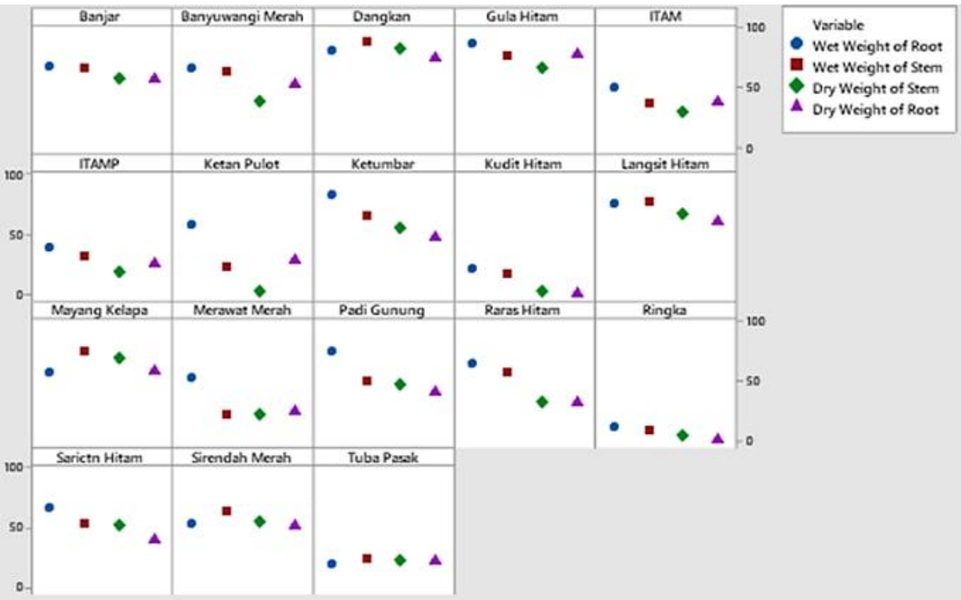

Fig. 5: Percentage reduction in root fresh weight, root dry weight, shoot fresh weight, and shoot dry weight of 18 local rice genotypes bioprimed with WH3.1C isolate under 4000ppm NaCl-induced salinity stress.

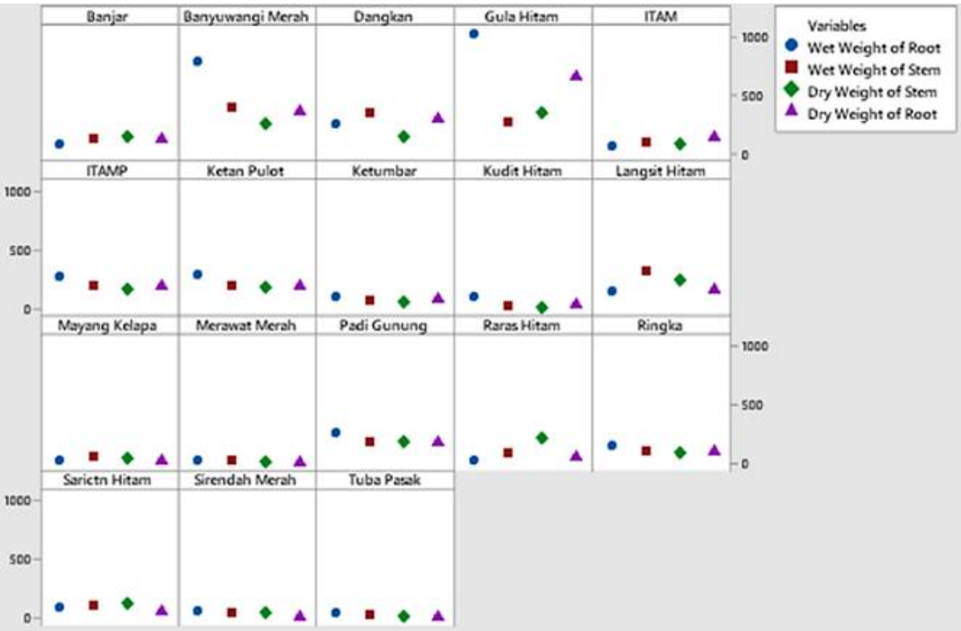

Fig. 6: Percentage increase in wet weight and dry weight of roots, as well as wet weight and dry weight of the seedling shoot of 18 local rice that were given biopriming using WH3.1C isolat under salinity stress conditions with NaCl of 4000ppm.

There was a decrease in the percentage of wet weight and dry weight of the roots as well as the wet and dry weight of the shoot of 18 local rice seedlings that were given 4000ppm salinity, with different responses. The local Dangkan and Black Sugar rice showed a large reduction in wet and dry weight in the roots and stems, almost 100%. In contrast, for local Ringka and Tuba Pasak rice, the decrease in wet and dry weight in the roots and stems was small (Fig. 5).

Fig. 6 shows that there was an increase in the percentage of wet weight and dry weight of roots as well as the percentage of wet and dry weight of the seedling shoot in all local rice that were given biopriming using biological agents WH3.1C isolate under salinity stress conditions with NaCl concentration of 4000ppm. An interesting thing happened in the local Banyuwangi Merah and Gula Hitam rice, there was an increase in the percentage of wet root weight after being given the WH31.C isolate up to 800-1000%. Local Gula Hitam rice also showed a high increase in root dry weight percentage, namely 670%. The increase in the percentage of wet and dry weight in the roots and the percentage of wet and dry weight in the stems in the other 16 local rice plants tended to be small. The local Ringka and Tuba pasak rice showed consistent characteristics in responding to the salinity stress given and in responding to the provision of biological agents, both of which had small decreases in the percentage of wet weight and dry weight in both roots and stems when given a salinity stress of 4000ppm and there was also a small increase in the percentage of wet weight and dry weight in both roots and stems when given the biological agents WH3.1C. Likewise, local Gula Hitam rice is also consistent in responding to salinity stress and in responding to the provision of biological agents. When given stress with 4000ppm NaCl salinity, it resulted in a very large decrease in the percentage of wet weight and dry weight in both roots and stems, and when given biological agents WH3.1C there was a very high increase in the percentage of wet weight and dry weight in roots.

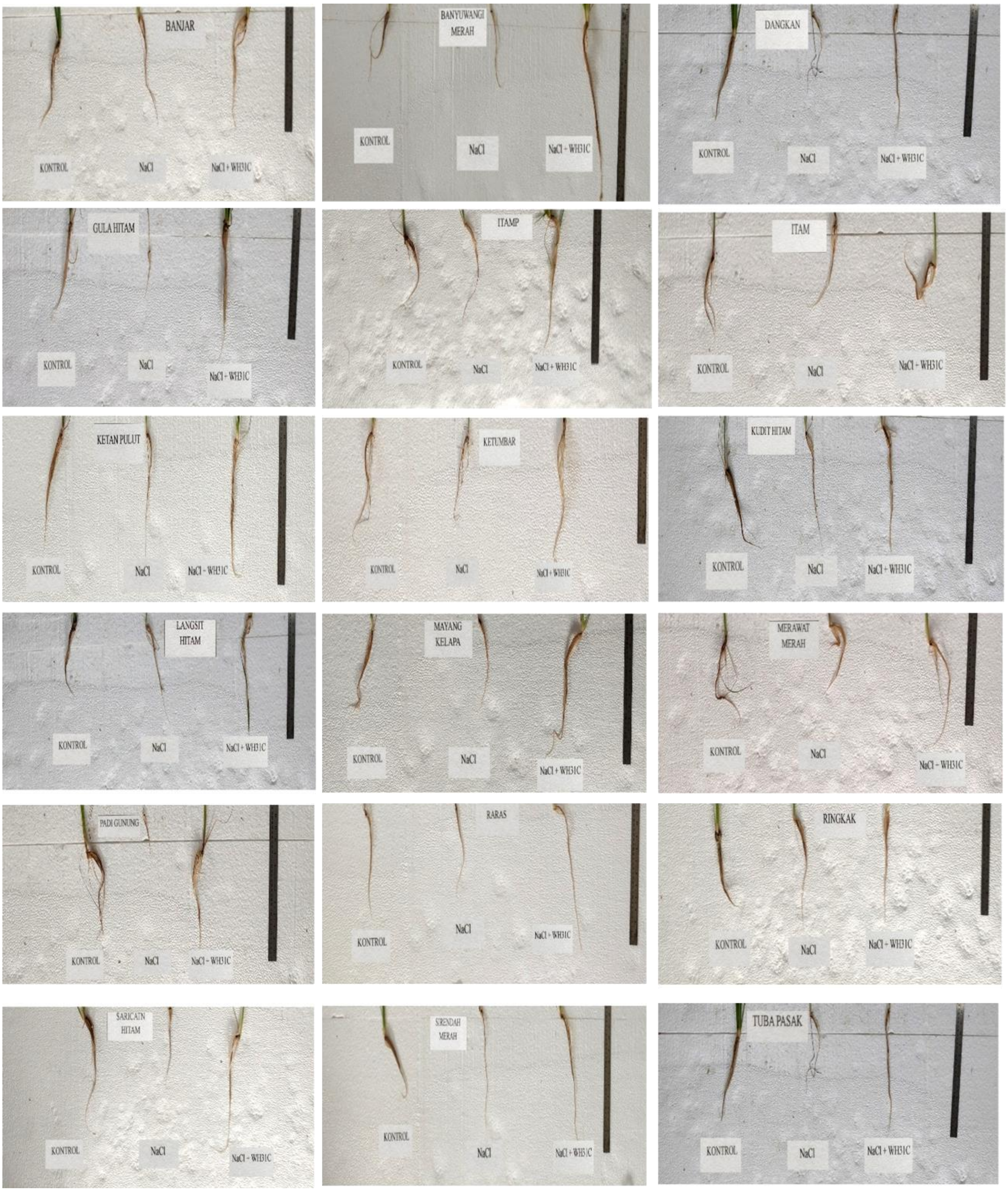

Fig. 7: Root length of 18 local rice that were given biopriming using WH3.1C isolate under salinity stress conditions with NaCl of 4000ppm.

This indicates that the local Ringka and Tuba pasak rice tend to be tolerant in response to salinity stress and when given biological agents, while Gula Hitam is sensitive to salinity stress and when given WH3.1C isolate. As stated previously by Nurahmadi et al. (2019), the different advantages in growth characteristics displayed by rice types are due to different genetic capabilities. The root lenght of the 18 local rice tested can be seen in Fig. 7.

Conclusion

The results of the research showed that genotypes of local rice showed different growth responses to 4000ppm NaCl. Application of WH3.1C isolate to water culture media that had previously been subjected to 4000ppm NaCl gave growth of rice that was not different from rice that were not subjected to salinity stress. The percentage of wet weight of root Banyuwangi Merah and Gula Hitam seedlings increased by 800-1000% after being treated with the WH31.C isolate. Black Sugar Rice also showed a percentage increase in root dry weight of 670%. This was suggested that WH3.1C isolate had capability to minimize the impact of salinity on the 18 local rice seedlings tested.

DECLARATIONS

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