Agronomic performance and yield of hybrid rice genotypes in preliminary yield trial

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Abstract. Research on hybrid rice in Indonesia began in 1983 with the aim of exploring the prospects and constraints of this technology. Until 2019 the Indonesian government through Indonesia Agricultural Agencies Research and Development has released 21 hybrid rice varieties. 42 hybrid rice genotypes and one check variety namely Hipa 18 were tested during the season of 2014 in Sukamandi Experimental Station. Randomized complete block design (RCBD) with three replications was used in each season. The results showed that variation due to genotype were significant for all traits except panicle length. Genotype by season (GXS) interactions cause differences in productivity. Twenty one hybrid rice genotypes were selected on productivity and selection index based on contributed traits of yield i.e tiller number, number of filled grain per panicle, 1000-grain weight, and productivity according to their relative weight. Those selected hybrids were HRDC 1440, HRDC 1415, HRDC 1404, HRDC 1407, HRDC 1431, HRDC 1421, HRDC 1434, HRDC 1438, HRDC 1423, HRDC 1414, HRDC 1426, HRDC 1429, HRDC 1443, HRDC 1441, HRDC 1406, HRDC 1408, HRDC 1446, HRDC 1422, HRDC 1445, HRDC 1417 and HRDC 1419. The productivity range of those hybrids were 6.1 – 10.2 ton ha-1. The selected hybrid rice genotypes can be evaluated further in advanced yield trials.

1. Introduction
Rice (Oryza sativa L) is the second staple food for more than one-third of the world’s population [1]. The population in the world is estimated at 8 billion by 2030, so rice production must increase by 50% to meet food needs [2]. In Indonesia, the productivity of rice today seems stagnant, even in some regions it has decreased due to biotic, abiotic, and global climate change stresses. One alternative in increasing productivity is utilizing the symptoms of heterosis of hybrid rice [3]. Hybrid rice referred to as the F1, is the product of crossing two rice plants with superior qualities. These superior qualities of both parents are passed on to the seed and results in a phenomenon called ‘hybrid vigor’ or ‘heterosis’ [4]. The commercial hybrid refers to a superior F1, which not only outperforms the better parent but also shows significant (at least 1-ton ha−1) yield superiority over the best high-yielding inbred variety of similar duration and possesses acceptable grain quality. This technology has been applied successfully in China since 1976 [5].

Indonesia has been active in developing hybrid rice as an alternative strategy to improve rice yield. Research on hybrid rice in Indonesia began in 1983 with the aim of exploring the prospects and constraints of this technology. Up to 2011, Indonesian Center for Rice Research has released 17 hybrid rice varieties with some yield advantage over inbred varieties, Ciherang and IR64 as popular
varieties [6]. In 2013, Indonesia Center for Rice Research released two hybrid rice varieties i.e Hipa 18 and Hipa 19. Two other hybrid rice varieties have been released in early 2019 namely Hipa 20 and Hipa 21. In Indonesia, hybrid rice can be grown in the wet and dry season. The rainy season is generally characterized by a decrease in the average daily temperature, shorter solar radiation, and lower solar radiation, high rainfall, and cloudy sky (cloudy). Conversely, the dry season is characterized by high daily average air temperature, high solar radiation, longer solar radiation, and decreased air humidity [7]. Today there are frequent changes and irregularities in climate patterns that affect crop production [8, 9].

Improvement of rice grain yield is the main target of a breeding programs to develop rice varieties for diverse ecosystems including hybrid rice. In addition, grain yield also related with other characters such as plant type, growth duration, and yield components, hence direct selection is not much effective on this character [10], and it is very risky to select only based on productivity [11]. Interconnected characters were needed to increase the grain yield [12]. Selection of high yield genotypes may be more effective if it also involves the determination of traits contributing to or affecting the yield traits. Selection as a part of a breeding program will give an optimum response when using the appropriate selection criteria [13]. The use of selection index is one of the useful methods to overcome this problem. Selection can be done by using the selection index when considering several traits simultaneously because it is desirable to choose individuals with the best combination of these traits [14, 15, 16, 12]. The aims of this research were to conduct preliminary yield trial (PYT) to obtain potential hybrid rice genotypes that have good agronomic performance based on the selection index.

2. Materials and Methods

The materials consisted of 42 hybrid rice genotypes i.e HRDC 1401, HRDC 1402, HRDC 1403, HRCD 1404, HRDC 1405, HRDC 1406, HRDC 1407, HRDC 1408, HRDC 1409, HRDC 1410, HRDC 1414 to HRDC 1446 and one check variety Hipa 18 Experimental Procedures.

The research was conducted in two seasons (wet season and dry season) of 2014 in Sukamandi Experimental Station, Subang West Java Province. In each season, each genotype was planted in a plot of 2 m x 5 m with a planting space of 20 cm x 20 cm, so there will be 10 rows and 25 planting hills each plot (population per plot 250 hills). In each season, plant maintenance was carried out according to the appropriate standard practice of rice production. The seeds were planted 1-2 seedling plants per hill. Fertilizers used were NPK sources, namely urea with a dose of 300 kg ha\(^{-1}\), SP-36 100 kg ha\(^{-1}\) and KCl 100 kg ha\(^{-1}\). Fertilizers were given in three stages: (1). The first fertilization was given one week after planting (WAP), i.e. 100 kg ha\(^{-1}\) urea, 100 kg ha\(^{-1}\) SP-36 and 75 kg ha\(^{-1}\) KCl; (2). The second fertilization was given at four WAP (100 kg ha\(^{-1}\) urea); (3). The third fertilization was given at seven WAP (100 kg ha\(^{-1}\) urea and 25 kg ha\(^{-1}\) KCL). Harvesting was carried out when 80% of rice panicles in one plot turned yellow. Seeds were harvested to estimate grain yield per plot. The grain was dried to reach ±14% moisture content and later converted to dry grain yield per hectare (ton ha\(^{-1}\)).

Variables observed based on Standard Evaluation System for Rice from IRRI [17]. The productivity (P) was measured. The other productivity-related traits: tiller number (TN); filled grain number (FGN), and 1000-grain weight (TGW) and panicle length (PL). Grain yield data and the other yield related traits were subjected to a combined analysis of variance following Randomized Complete Block Design, format using STAR software.

The selection index was determined by the following formula [18]:

\[ Y_{ij} = \mu + \tau_i + \beta_j + e_{ij} \]

where: \(Y_{ij}\): b1X1 + b2X2 + b3X3 + ... + bnXn; I: selection Index; B: the weight of the variable to n; Xn : standardized phenotype value for variables to n. The selected agronomic important traits (X) were weighted, i.e. productivity: +5, the tiller number: +1, the number of filled grain per panicle: +1, the percentage of filled grain per panicle (seedset): +1, total number of spikelet per panicle: +2, 1000-grain weight: +1 and days to harvest: -1 [13].
3. Results and Discussion

3.1. Analysis of Variance of Productivity and Related Traits

Analysis of variance showed that variation due to genotype were significant for all traits except panicle length (Table 1). Similar findings by Widyastuti et al. [6], that panicle length were not affected by genotype. The variation for the traits of tiller number filled grain number and productivity was also significant due to season. The Interaction between genotype and season (GXS) were significant except for tiller number and panicle length. Genotype x season (GXS) interactions cause differences in productivity. Based on this research, however, panicle length and number of tillers were not affected by this interaction. The significant values of analysis of variance showed that these genotypes were varied for the test traits, so the selection could be done [19].

| Traits              | F Values of Genotype (G) | Season (S) | GXS  | CV %   |
|---------------------|--------------------------|------------|------|--------|
| Tiller number       | 1.77 **                  | 12.63 *    | 1.33 ns | 18.00  |
| Filled grain number | 2.53 **                  | 20.91 *    | 1.56 * | 16.29  |
| 1000 grain weight   | 4.08 **                  | 22.11 ns   | 5.21 ** | 4.36   |
| Panicle length      | 1.00 ns                  | 0.37 ns    | 1.02 ns | 67.97  |
| Productivity        | 1.64 **                  | 698.09 **  | 7.18 ** | 9.27   |

3.2. Agronomic Performances and Productivity

Agronomic performances are presented in Table 2, while productivity in Table 3. The mean of the tiller number ranged from 10.0 to 15.2 stems/hill. HRDC 1403 has the lowest tiller number and HRDC 1440 has the highest number of the productive tiller. The productive tiller number 10-19 stems/hill is grouped into a medium category, productive tiller number 20 to 25 stems into high category and productive tiller number more than 25 stems into very high category [20]. Productive tiller number in the tested of hybrid rice genotypes was medium. HRDC 1409, HRDC 1425, HRDC 1439, HRDC 1440 and HRDC 1444 have a higher number of productive tiller than Hipa 18 as check variety (Table 2).

Panicle length was one of the traits that contributed to shape and size [21]and an important component in rice productivity [6]. The mean of panicle length ranged from 24.9 cm to 32.7 cm. The shortest panicle length is owned by HRDC 1415, while the longest panicle is owned by Limboto and Inpago 10 HRDC 1418. Hipa 18 as check variety has a panicle length of 28.4 cm. HRDC 1418 was a hybrid genotype that potential to produce high production. Rice plants with long panicles potentially have a high number of grain total and high yield [22]. Panicle length is categorized into 3 classes, namely short (<25 cm), medium (25-30 cm) and long (> 30 cm) panicles [23]. Most of the tested hybrid genotypes were categorized as medium panicle length except HRDC 1418 (32.7 cm), HRDC 1432 (31.5cm) and HRDC 1445 (31.0 cm).

The Mean of a number of filled grain/panicles ranged from 148.3 to 234.0 (Table 3). Hipa 18 has 167.7 number per panicle. The lowest number of filled grain/panicle is owned by HRDC 1403, while the highest number of filled grain is owned by HRDC 1408. Twenty three hybrid rice genotypes have more number per panicle than Hipa 18 (167.7), (Table 3).
Table 2. Number of productive tiller number and panicle length of 43 hybrids rice

| Genotypes     | Productive tiller numbers | Panicle length (cm) |
|---------------|---------------------------|---------------------|
|               | SKL, DS                   | SKL, WS             | Mean     | SKL, DS | SKL, WS | Mean     |
| HRDC 1401     | 11.7                      | 12.0                | 11.9     | 27.2    | 26.8    | 27.0     |
| HRDC 1402     | 9.9                       | 13.0                | 11.4     | 27.2    | 25.7    | 26.4     |
| HRDC 1403     | 10.7                      | 9.3                 | 10.0     | 25.7    | 26.8    | 26.2     |
| HRDC 1404     | 10.5                      | 13.6                | 12.1     | 26.3    | 28.8    | 27.6     |
| HRDC 1405     | 11.1                      | 13.4                | 12.2     | 26.5    | 29.1    | 27.8     |
| HRDC 1406     | 13.4                      | a                   | 12.9     | 13.2    | 28.0    | 27.2    | 27.6     |
| HRDC 1407     | 10.4                      | 12.4                | 11.4     | 26.2    | 27.9    | 27.0     |
| HRDC 1408     | 10.9                      | 13.3                | 12.1     | 27.0    | 25.7    | 26.4     |
| HRDC 1409     | 12.4                      | 16.3                | a        | 14.3    | a       | 27.0    | 28.5    | 27.8     |
| HRDC 1410     | 12.1                      | 14.5                | 13.3     | 27.4    | 29.3    | 28.3     |
| HRDC 1411     | 10.5                      | 11.3                | 10.9     | 24.5    | 26.5    | 25.5     |
| HRDC 1412     | 10.7                      | 14.2                | 12.5     | 24.1    | 25.8    | 24.9     |
| HRDC 1413     | 11.2                      | 13.8                | 12.5     | 27.0    | 28.1    | 27.5     |
| HRDC 1414     | 10.3                      | 13.6                | 11.9     | 28.1    | 30.0    | 29.0     |
| HRDC 1415     | 10.2                      | 13.4                | 11.8     | 28.2    | 37.2    | a       | 32.7    | a       |
| HRDC 1416     | 11.4                      | 16.4                | a        | 13.9    | 27.0    | 28.0    | 27.5     |
| HRDC 1417     | 10.5                      | 14.6                | 12.6     | 29.2    | 29.8    | 29.5     |
| HRDC 1418     | 10.5                      | 11.0                | 10.8     | 28.9    | 28.4    | 28.7     |
| HRDC 1419     | 10.4                      | 12.8                | 11.6     | 27.7    | 29.7    | 28.7     |
| HRDC 1420     | 10.2                      | 12.7                | 11.5     | 27.8    | 28.1    | 28.0     |
| HRDC 1421     | 9.7                       | 13.8                | 11.7     | 29.6    | 29.4    | 29.5     |
| HRDC 1422     | 10.8                      | 17.7                | a        | 14.3    | a       | 31.6    | 28.1    | 29.8     |
| HRDC 1423     | 9.0                       | 11.2                | 10.1     | 28.0    | 28.0    | 28.0     |
| HRDC 1424     | 8.7                       | 15.2                | a        | 12.0    | 28.4    | 29.1    | 28.7     |
| HRDC 1425     | 9.8                       | 13.3                | 11.6     | 27.8    | 28.9    | 28.3     |
| HRDC 1426     | 10.5                      | 14.5                | 12.5     | 25.6    | 27.4    | 26.5     |
| HRDC 1427     | 10.4                      | 13.2                | 11.8     | 27.6    | 28.3    | 28.0     |
| HRDC 1428     | 11.8                      | 13.2                | 12.5     | 27.1    | 28.0    | 27.5     |
| HRDC 1429     | 9.3                       | 12.8                | 11.0     | 26.6    | 36.3    | a       | 31.5     |
| HRDC 1430     | 11.5                      | 13.2                | 12.4     | 25.3    | 28.3    | 26.8     |
| HRDC 1431     | 10.5                      | 13.1                | 11.8     | 25.5    | 27.6    | 26.6     |
| HRDC 1432     | 10.5                      | 12.8                | 11.6     | 28.6    | 30.2    | 29.4     |
| HRDC 1433     | 10.2                      | 13.7                | 12.0     | 25.3    | 26.8    | 26.1     |
| HRDC 1434     | 11.0                      | 14.0                | 12.5     | 25.9    | 28.8    | 27.3     |
| HRDC 1435     | 12.2                      | a                   | 17.4     | a       | 14.8    | a       | 27.1    | 28.3    | 27.7     |
| HRDC 1436     | 13.7                      | a                   | 16.6     | a       | 15.2    | a       | 25.8    | 35.6    | a       | 30.7     |
| HRDC 1441     | 11.5                      | 11.6                | 11.6     | 27.4    | 28.2    | 27.8     |
| HRDC 1442     | 11.8                      | 11.1                | 11.5     | 25.5    | 26.4    | 25.9     |
| HRDC 1443     | 12.2                      | a                   | 12.4     | 12.3    | 27.2    | 26.4    | 26.8     |
| HRDC 1444     | 13.8                      | a                   | 14.1     | 14.0    | 130.0   | 27.6    | 29.3     |
| HRDC 1445     | 12.8                      | a                   | 14.8     | 13.8    | 33.5    | a       | 28.5    | 31.0     |
| HRDC 1446     | 12.2                      | a                   | 12.1     | 12.1    | 24.2    | 28.0    | 26.1     |
| Hipa 18       | 11.9                      | 14.0                | 12.9     | 27.4    | 29.4    | 28.4     |

| Mean          | 12.3                      |                     | 27.9     |
| LSD 5%        | 0.6                       |                     | 4.9      |
| CV (%)        | 17.9                      |                     | 67.7     |

Letter “a” indicate significantly higher than Hipa 18
SKI = Sukamandi; DS = dry season; WS = wet season

The 1000-grain weight in the hybrids ranged from 23.2-32.8 grams (Table 3). Fourteen hybrid rice showed significantly higher than Hipa 18 (25.7 g). Hybrids HRDC 1508 produced the minimum 1000-grain weight (23.2 g). Hybrid HRDC 1429 produced the highest (32.8 g) 1000 weight grain. Similarly, 1000-grain weight is also an important component that contributes towards the increase in yield.
| Geno  | Number of filled grain/panicle | 1000 weight grain | Yield (ton ha⁻¹) |
|-------|-------------------------------|-------------------|-----------------|
|       | SKL, DS | SKL, WS | X | SKL, DS | SKL, WS | X | SKL, DS | SKL, WS | X |
| HRDC 1401 | 192.1 a | 169.7 a | 180.9 a | 26.0 | 24.2 | 25.1 | 7.2 | 5 | 6.1 |
| HRDC 1402 | 235.7 a | 143.9 a | 189.8 a | 25.1 | 24.3 | 24.7 | 8 | 4.5 | 6.2 |
| HRDC 1403 | 174.2 a | 122.4 a | 148.3 31.7 a | 32.7 a | 32.2 a | 7.7 | 4.4 | 6 |
| HRDC 1404 | 244.5 a | 198 a | 221.3 a | 28.2 | 28.5 a | 28.3 a | 7.4 | 6 | a 6.7 |
| HRDC 1405 | 185.5 a | 164 a | 174.8 25.4 | 22.8 | 24.1 | 7.2 | 6.2 | a 6.7 |
| HRDC 1406 | 224.6 a | 160.2 a | 192.4 a | 27.5 | 24.5 | 26.0 | 7.2 | 6.1 | a 6.7 |
| HRDC 1407 | 230.5 a | 219.6 a | 225.1 a | 28.5 a | 26.8 | 27.7 a | 8.4 a | 5.4 | 6.9 |
| HRDC 1408 | 258.4 a | 209.6 a b | 234 a | 26.1 a | 20.3 a | 23.2 | 6.5 | 5.6 | 6.1 |
| HRDC 1409 | 194.3 a | 150.1 a | 172.2 25.5 | 23.0 | 24.2 | 7.8 | 5.4 | 6.6 |
| HRDC 1410 | 169.1 a | 149.6 a | 159.4 28.0 a | 25.7 | 26.9 | 7.2 | 6 a 6.6 |
| HRDC 1411 | 178.1 a | 164.1 a | 171.1 | 31.8 a | 29.0 a | 30.4 a | 8.4 a | 6.2 a 7.3 a |
| HRDC 1412 | 207.6 a | 196.7 a | 202.2 a | 29.0 a | 26.8 a | 27.9 a | 8.5 a | 7.6 a 8 a |
| HRDC 1413 | 188.5 a | 144.9 a | 166.7 | 31.6 a | 27.8 a | 29.7 a | 6.9 | 5.9 | 6.4 |
| HRDC 1414 | 215.5 a | 174.9 a | 195.2 a | 28.1 a | 24.8 a | 26.5 | 6.8 | 6.4 a 6.6 |
| HRDC 1415 | 177.7 a | 139.5 a | 158.6 29.0 a | 24.7 | 26.9 | 5.2 | 5.9 | 5.6 |
| HRDC 1416 | 154.7 a | 173.2 a | 163.9 | 30.7 a | 26.6 | 28.7 a | 7.7 | 6 a 6.9 |
| HRDC 1417 | 222.9 a | 166.1 a | 194.5 a | 27.7 a | 24.0 a | 25.8 | 7.1 | 5.4 | 6.3 |
| HRDC 1418 | 249.8 a | 178 a | 213.9 a | 30.1 a | 27.3 a | 28.7 a | 8 | 4.9 | 6.4 |
| HRDC 1419 | 206 a | 181.5 a | 193.8 a | 30.2 a | 26.1 | 28.1 a | 7.1 | 5.7 | 6.4 |
| HRDC 1420 | 238.5 a | 172.2 a | 205.3 a | 30.1 a | 27.2 a | 28.7 a | 9.5 a | 4 | 6.8 |
| HRDC 1421 | 213.4 a | 168 a | 190.7 a | 29.7 a | 26.6 | 28.2 a | 6 | 5.6 | 5.8 |
| HRDC 1422 | 214.4 a | 140.3 a | 177.4 a | 29 a | 24.7 | 26.8 | 6.6 | 5 | 5.8 |
| HRDC 1423 | 251 a | 207.9 a | 229.4 a | 27.8 a | 25.4 a | 26.6 | 6.5 | 6.6 a 6.5 |
| HRDC 1424 | 182.7 a | 159.3 a | 171 a | 28 a | 24.7 a | 26.3 a | 6.7 | 5.3 | 6 |
| HRDC 1425 | 184.2 a | 159.2 a | 171.7 27.6 a | 24.3 a | 25.9 | 7.1 | 5.3 | 6.2 |
| HRDC 1426 | 173 a | 132.1 a | 152.5 32.7 a | 32.9 a | 32.8 a | 8.2 | 7 a 7.6 a |
| HRDC 1427 | 193.2 a | 163.9 a | 178.6 a | 24.7 a | 24.8 a | 24.7 | 5.9 | 4.4 | 5.2 |
| HRDC 1428 | 163.9 a | 149.3 a | 156.6 28.5 a | 29.6 a | 29 a | 10.2 a | 6.5 a 8.3 a |
| HRDC 1429 | 233.9 a | 211.3 a | 222.6 a | 25 a | 22.6 | 23.8 | 8 | 5.7 | 5.9 |
| HRDC 1430 | 217.3 a | 165.5 a | 191.4 a | 23 a | 27.2 a | 25.1 | 5.8 | 5 | 5.4 |
| HRDC 1431 | 278.9 a | 183.2 a | 231.1 a | 22.5 a | 24.5 a | 24.5 | 7.9 | 4.9 | 6.4 |
| HRDC 1432 | 179 a | 173.5 a | 176.2 a | 25.2 a | 24.5 a | 24.8 | 6.9 | 6.4 a 6.6 |
| HRDC 1433 | 192.1 a | 160.8 a | 176.5 a | 23.1 a | 24.6 a | 23.9 | 8.4 a | 3.2 | 5.8 |
| HRDC 1434 | 178.3 a | 161.4 a | 169.8 a | 29.2 a | 29.3 a | 29.2 a | 9.2 a | 6.4 | 7.8 a |
| HRDC 1435 | 178.4 a | 133.5 a | 160.9 a | 25.2 a | 26.2 a | 25.7 | 8 a 6.3 | 7.1 a |
| HRDC 1436 | 162.2 a | 161.7 a | 162 a | 26.9 a | 27 a | 26.9 a | 12.7 a | 7.6 a 10.2 a |
| HRDC 1437 | 189 a | 168.8 a | 178.9 a | 26.3 a | 26.3 a | 26.3 | 7.1 | 5.5 | 6.3 |
| HRDC 1438 | 168.5 a | 139 a | 153.2 a | 26 a | 27 a | 26.5 a | 6.8 | 5.2 | 6 |
| HRDC 1439 | 167.6 a | 196.1 a | 181.9 a | 26.7 a | 21.6 a | 24.2 a | 8.2 | 5.7 | 6.9 |
| HRDC 1440 | 173 a | 132.9 a | 152.9 a | 27.6 a | 25.6 a | 26.6 | 7.5 | 4.9 | 6.2 |
In average, the yield of the hybrid rice was higher in dry season compared to rainy season (Table 4). Yield of hybrid rice in the dry season was 7.9 ton ha\(^{-1}\), while in the rainy season was 5.1 ton ha\(^{-1}\). The yield in two seasons was 6.6 ton ha\(^{-1}\). Thirty six hybrid rice genotypes have the similar productivity to Hipa 18, while there were seven hybrid rice higher productivity than to Hipa 18 (6.5 ton ha\(^{-1}\)). Those hybrids were HRDC 1414 (7.3 ton ha\(^{-1}\)), HRDC 1415 (8.0 ton ha\(^{-1}\)), HRDC 1429 (7.6 ton ha\(^{-1}\)), HRDC 1431 (8.3 ton ha\(^{-1}\)), HRDC 1438 (7.8 ton ha\(^{-1}\)), HRDC 1439 (7.1 ton ha\(^{-1}\)), and HRDC 1440 (10.2 ton ha\(^{-1}\)).

3.3. Selection Criteria based on weighted index

Ranks assessed by hybrid rice genotypes based on the weighted selection index are presented in Table 4. In this research several traits of agronomic importance such as productivity, number of tillers, number of filled grains per panicle, the percentage of filled grains per panicle, total number of spikelets per panicle, 1000-grain weight and days to harvest were chosen and weighted. The weighting should be based on the level of economic interests of each character in order to reduce subjectivity by breeders [13].

The weighted index value ranged from 16.3 (HRDC 1440) to 11.1 (HRDC 1418). Hipa 18 has a selection index value of 2.4 and a productivity of 6.5-ton ha\(^{-1}\). Based on the weighted selection index, 21 hybrid rice genotypes were obtained with a high selection index and positive values. Those hybrid rice were HRDC 1440, HRDC 1415, HRDC 1404, HRDC 1407, HRDC 1431, HRDC 1421, HRDC 1434, HRDC 1438, HRDC 1423, HRDC 1414, HRDC 1426, HRDC 1429, HRDC 1443, HRDC 1441, HRDC 1406, HRDC 1408, HRDC 1446, HRDC 1442, HRDC 1445, HRDC 1417 and HRDC 1419.

| Genotype   | TN   | NFG  | 1000-WG | Productivity (ton ha\(^{-1}\)) | Weighted index |
|------------|------|------|---------|-------------------------------|---------------|
| HRDC 1440  | 15.2 | 162.0| 26.9    | 10.2                          | 16.3          |
| HRDC 1415  | 12.5 | 202.2| 27.9    | 8.0                           | 9.8           |
| HRDC 1404  | 12.1 | 221.3| 28.3    | 6.7                           | 8.5           |
| HRDC 1407  | 11.4 | 225.1| 27.7    | 6.9                           | 7.9           |
| HRDC 1431  | 12.5 | 156.6| 29.0    | 8.3                           | 6.3           |
| HRDC 1421  | 10.8 | 213.9| 28.7    | 6.4                           | 6.1           |
| HRDC 1434  | 11.8 | 231.1| 23.5    | 6.4                           | 5.5           |
| HRDC 1438  | 12.5 | 169.8| 29.2    | 7.8                           | 5.1           |
| HRDC 1423  | 11.5 | 205.3| 28.7    | 6.8                           | 3.9           |
| HRDC 1414  | 10.9 | 171.1| 30.4    | 7.3                           | 3.4           |
| HRDC 1426  | 10.1 | 229.4| 26.6    | 6.5                           | 3.2           |
Twenty-one hybrid rice genotypes selected were potential hybrids that have good agronomic performance based on the selection index. Those hybrids can be continued further in advance yield trials to get the best candidate for hybrid rice in the future.

4. Conclusion

Based on weighted index value, good agronomic performance and yield (6.1 – 10.2 ton ha\(^{-1}\)), there were 21 hybrid rice genotypes were selected (HRDC 1440, HRDC 1415, HRDC 1404, HRDC 1407, HRDC 1431, HRDC 1421, HRDC 1434, HRDC 1438, HRDC 1423, HRDC 1414, HRDC 1426, HRDC 1429, HRDC 1443, HRDC 1441, HRDC 1406, HRDC 1408, HRDC 1446, HRDC 1422, HRDC 1445, HRDC 1417 and HRDC 1419). The selected hybrid rice genotypes is recommended for further evaluation in advance yield trials.

| Genotype  | TN  | NFG | WG  | Index \(\times 100\) | Yield \(\times 100\) |
|-----------|-----|-----|-----|----------------------|---------------------|
| HRDC 1429 | 12.5 | 152.5 | 32.8 | 7.6  | 3.1     |
| HRDC 1443 | 12.3 | 181.9 | 24.2 | 6.9  | 2.4     |
| HRDC 1441 | 11.6 | 178.9 | 26.3 | 6.3  | 2.0     |
| HRDC 1406 | 13.2 | 192.4 | 26.0 | 6.7  | 1.5     |
| HRDC 1408 | 12.1 | 234.0 | 23.2 | 6.1  | 1.3     |
| HRDC 1446 | 12.1 | 164.7 | 26.3 | 6.8  | 1.1     |
| HRDC 1422 | 11.6 | 193.8 | 28.1 | 6.4  | 0.7     |
| HRDC 1445 | 13.8 | 148.3 | 26.0 | 6.9  | 0.6     |
| HRDC 1417 | 11.9 | 195.2 | 26.5 | 6.6  | 0.6     |
| HRDC 1419 | 13.9 | 163.9 | 28.7 | 6.9  | 0.4     |
| HRDC 1439 | 14.8 | 160.9 | 25.7 | 7.1  | 0.0     |
| HRDC 1403 | 10.0 | 148.3 | 32.2 | 6.0  | -0.9    |
| HRDC 1432 | 11.0 | 222.6 | 23.8 | 5.9  | -1.3    |
| HRDC 1420 | 12.6 | 194.5 | 25.8 | 6.3  | -1.8    |
| HRDC 1424 | 11.7 | 190.7 | 28.2 | 5.8  | -1.8    |
| HRDC 1402 | 11.4 | 189.8 | 24.7 | 6.2  | -2.0    |
| HRDC 1409 | 14.3 | 172.2 | 24.2 | 6.6  | -2.3    |
| HRDC 1410 | 13.3 | 159.4 | 26.9 | 6.6  | -2.4    |
| Hipa 18  | 12.9 | 167.7 | 25.7 | 6.5  | -2.4    |
| HRDC 1425 | 14.3 | 177.4 | 26.8 | 5.8  | -3.0    |
| HRDC 1416 | 12.5 | 166.7 | 29.7 | 6.4  | -3.4    |
| HRDC 1405 | 12.2 | 174.8 | 24.1 | 6.7  | -3.6    |
| HRDC 1444 | 14.0 | 152.9 | 26.6 | 6.2  | -3.8    |
| HRDC 1401 | 11.9 | 180.9 | 25.1 | 6.1  | -4.5    |
| HRDC 1436 | 11.6 | 176.2 | 24.8 | 6.6  | -4.6    |
| HRDC 1442 | 11.5 | 153.2 | 26.5 | 6.0  | -4.7    |
| HRDC 1428 | 11.6 | 171.7 | 25.9 | 6.2  | -6.2    |
| HRDC 1427 | 12.0 | 171.0 | 26.3 | 6.0  | -6.4    |
| HRDC 1433 | 12.4 | 191.4 | 25.1 | 5.4  | -7.5    |
| HRDC 1437 | 12.0 | 176.5 | 23.9 | 5.8  | -7.6    |
| HRDC 1430 | 11.8 | 178.6 | 24.7 | 5.2  | -8.6    |
| HRDC 1418 | 11.8 | 158.6 | 26.9 | 5.6  | -11.1   |

Note: TN=tiller number; NFG=Number of filled grain; WG= weight grain
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