Rice lines potentially as new varieties for acidic dry lands

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Abstract. Dry land has great potential to support programs to increase national rice production by increasing the planted area. The aim of the study was to evaluate the yield of upland rice lines to obtain several lines of upland rice which had high yield and had the potential to be released as new varieties for acid dry land. The experiment was carried out in Lampung on DS 2020. A total of 60 advanced upland rice lines and comparison varieties were used as material for this experiment. The variables observed were plant height, number of productive tillers, age of flowering plants (50%), harvestable age (80% yellowing of rice), number of filled and empty grains per panicle, weight of 1000 filled grains, yield, milled dry grain and its resistance to biotic and abiotic stress. From the preliminary yield test, ten lines showed comparable yields above the best comparison variety Inpago 12. The lines were B14986E-MR-26 (6.78 t/ha), B15151E-MR-23 (6.39 t/ha), B15151E-MR-21 (6.61 t/ha), B15151E-MR-18 (5.95 t/ha), B15340-2B-TB-23 (5.87 t/ha), B15154E-MR-2 (6.33 t/ha), B15151E-MR-1 (5.78 t/ha), B13017B-RS*1-2-6-PN-11-2-1 (5.94 t/ha) and B15511D-KR-31 (6.32 t/ha). Those lines have long (L), medium (M) and medium chalkiness (M) sizes. The rice texture is between medium and soft.

1. Introduction
The upland rice breeding program is aimed at assembling upland rice varieties that have high yield potential, are tolerant of certain biotic and abiotic stresses, and have good quality rice. A number of high-yielding upland rice varieties have been released by the Agricultural Research and Development Agency [1]. The abiotic factors found in upland rice cultivation in red and yellow podzolic land are drought, soil acidity which is closely related to Al poisoning, and low soil fertility [2, 3, 4, 5].

Superior varieties such as Inpago 8, Inpago 9 and Inpago 12, adaptive in acid soil, also have a relatively high yield potential of 8-10 tonnes/ha [6]. Several varieties have also been widely grown in farmers such as Situ Patenggang and Batutegi. These varieties are directed to cultivate rice in lowland dry land as monoculture crops. The upland rice varieties that have been released have certain advantages, but they still have weaknesses. Further improvements are needed in particular to increase the genetic diversity of blast resistance and rice quality [7].

Rice grain quality depend on product characteristics could either be intrinsic, such as taste, texture, or colour; or extrinsic to the product, such as packaging, brand, or label [8]. Some attributes that define the quality of rice most preferred by consumers were taste, cooking quality, cooking time and aroma [9]. Variety that has good rice quality have higher selling value and can indirectly increase farmers’ income [10].
2. Material and Method

2.1. Time and Place
The experiment was carried out in Lampung on first planting season 2020.

2.2. Materials
A total of 60 advanced upland rice lines and four comparison varieties, i.e., Inpago 7, Inpago 8, Inpago 12, and Limboto were used as material for this experiment.

2.3. Experiment Design
Design of this experiment was randomize complete block design with three replication. The plot size is 1.8 m x 5 m, the spacing is 30 cm x 15 cm, plant the seeds directly by means of a hole, the number of seeds is 2-3 seeds per planting hole. The fertilizer used is 300 kg / ha NPK + 100 kg / ha Urea. Plants are maintained until harvest, control of pests and diseases following the IPM guidelines.

2.4. Observation
The variables observed were plant height, number of productive tillers, age of flowering plants (50%), harvestable age (80% yellowing of rice), number of filled and empty grains per panicle, weight of 1000 filled grains (14% moisture content), yield. milled dry grain (14% moisture content) and grain quality.

2.5. Data Analysis
Data were analyzed using analysis of variance. The difference in average between lines will be tested with the smallest real difference (LSD) at the real difference level of 5%.

3. Result and Discussion

3.1. Field Performance
The agronomic parameters observed included plant height, number of productive tillers, 50% flowering age and harvest age. The performance of upland rice lines is presented in Table 1. Documentation of activities of pest-resistant upland rice lines is shown in Figure 1. The results of the analysis showed that the average plant height of the lines ranged from 74 cm - 142 cm, the number of productive tillers ranged from 7-14 stems per clump, the flowering age ranged from 75 - 84 DAS, and the harvest age ranged from 92 - 106 DAS. Most of the lines tested had a higher plant height than the average of the four control varieties. A total of 28 lines had the number of productive tillers exceeding the average of the four comparison varieties with a range of 10-14 stems per hill. Flowering age and harvesting age of the comparison varieties used, Inpago 12 were among the fastest, 77 and 99 DAS, respectively. The analysis showed that the rice lines were not different from Inpago 12, each obtained as many as 16 lines.

Other agronomic characters observed were panicle length, number of filled grains, number of empty grains, weight of 1000 grains and yield of milled dry grain. The average panicle length of the lines was 26.3 cm, slightly longer than the average of the comparison varieties (25.5 cm). Of the 60 lines tested, 39 lines showed that their panicles were longer than all the comparison varieties. The average number of filled grains per panicle (121 grains) was higher than the average check (109 grains). Likewise, the average number of empty grains per panicle lines (62 grains) was higher than the check variety (53 grains). The Inpago 12 check variety had the highest number of filled grains, the lowest number of empty grains and the highest yield of milled dry grain. The lines tested with a higher number of filled grains than the best check varieties were obtained as many as 20 lines ranging from 134 - 213 grains. The lines tested with a significantly lower number of empty grain than the Inpago 12 check variety were obtained as many as 9 lines. The lines are B15151E-MR-18, B15340 -2B-TB-23, B15119C-TB-47, BP 30524D-SKI-2-3, B15150E-MR-
Table 1. Performance of upland rice lines at MT.1 2020 at Tamanbogo KP, Lampung

| No | Genotype          | PH (cm) | NP T (HSS) | DF 50% (HSS) | DF 80% (HSS) | PL (cm) | NFG/panicle (seed) | NEG/panicle (seed) | W1000 (g) | Y (t/ha) |
|----|-------------------|---------|------------|--------------|--------------|---------|--------------------|------------------|------------|---------|
| 1  | B15150E-MR-11     | 106.8   | 10 78      | 100 26.9     | 104 65       | 23.09   | 5.34               |
| 2  | B14986E-MR-26     | 107.4   | 14 79      | 101 25.1     | 118 43       | 25.46   | 6.78               |
| 3  | B14987E-MR-27     | 99.8    | 11 77      | 99 24.6      | 108 81       | 25.48   | 4.04               |
| 4  | B15151E-MR-23     | 111.8   | 9 78       | 100 25.8     | 123 41       | 23.98   | 6.39               |
| 5  | B15151E-MR-21     | 112.9   | 11 78      | 100 27.0     | 114 62       | 23.97   | 6.61               |
| 6  | B14986E-MR-10     | 114.4   | 9 76       | 98 23.8      | 132 71       | 24.23   | 4.29               |
| 7  | B15151E-MR-18     | 114.2   | 11 77      | 92 28.0      | 146 32       | 22.46   | 5.95               |
| 8  | B15150E-MR-50     | 119.2   | 8 80       | 102 24.7     | 148 137      | 26.86   | 5.15               |
| 9  | B15340-2B-TB-23   | 110.1   | 9 77       | 99 27.0      | 149 24       | 24.06   | 5.87               |
| 10 | B15145E-MR-2      | 123.8   | 9 79       | 101 28.3     | 150 43       | 24.77   | 6.33               |
| 11 | B14987E-MR-17     | 117.6   | 9 79       | 101 24.7     | 151 70       | 24.37   | 3.67               |
| 12 | B15151E-MR-1      | 121.9   | 10 77      | 100 28.7     | 159 60       | 25.02   | 5.78               |
| 13 | B15151E-MR-13     | 100.9   | 9 66       | 98 26.0      | 107 43       | 24.41   | 4.17               |
| 14 | B15177B-RS*1-2-6-PN-11-2-1-B15197B-MR-2-Blk-22 | 90.7 | 9 83 | 105 26.3 | 67 107 | 22.29 | 5.94 |
| 15 | B14171F-MR-1      | 111.0   | 10 80      | 102 28.2     | 213 53       | 22.79   | 3.68               |
| 16 | B15201B-MR-1-Blk-20 | 131.3 | 14 83 | 105 28.0 | 101 78 | 23.12 | 4.08 |
| 17 | B15191C-TB-47     | 124.0   | 8 76       | 98 27.6      | 145 79       | 24.58   | 3.99               |
| 18 |                    | 95.8    | 10 77      | 99 26.1      | 134 41       | 23.90   | 3.77               |
|    | B15119C-TB-24 | 115.7  | 10 | 80 | 102 | 28.6 | 144 | 73  | 24.87 | 4.53 |
|----|---------------|--------|----|----|-----|------|-----|-----|-------|------|
| 19 | B13017B-RS*1-2-6-PN-10-5-5 | 87.1   | 13 | 84 | 106 | 25.1 | 92  | 80  | 23.39 | 2.89 |
|    | B12743-MR-18-2-3-5-PN-10-3-1 | 93.4   | 10 | 83 | 105 | 25.4 | 99  | 69  | 23.11 | 3.34 |
| 20 | B12743-MR-18-2-3-2-PN-1-1-1-BP 30524-SKI-3-3 | 91.2   | 12 | 81 | 103 | 25.0 | 64  | 102 | 23.32 | 2.42 |
|    | B15119C-TB-43 | 117.1  | 6  | 79 | 101 | 29.0 | 101 | 110 | 24.46 | 3.99 |
| 21 | B15186C-TGB-43 | 94.0   | 9  | 78 | 100 | 27.1 | 87  | 42  | 23.48 | 1.40 |
|    | B14168E-MR-28 | 132.9  | 8  | 82 | 104 | 22.7 | 123 | 40  | 23.28 | 5.76 |
| 22 | B13498D-9 | 125.2  | 9  | 78 | 100 | 27.7 | 116 | 75  | 23.67 | 5.62 |
|    | B15198B-MR-1-2 | 116.7  | 8  | 76 | 98  | 24.7 | 128 | 55  | 23.80 | 5.63 |
| 23 | B15344B-TB-4 | 127.2  | 10 | 78 | 100 | 27.0 | 132 | 73  | 24.49 | 4.23 |
|    | B15344B-TB-31 | 122.1  | 10 | 80 | 102 | 28.4 | 108 | 66  | 25.32 | 3.82 |
| 24 | B15122C-TB-12 | 104.3  | 9  | 76 | 98  | 25.0 | 102 | 53  | 26.91 | 3.29 |
|    | B15120C-TB-42 | 121.7  | 9  | 75 | 104 | 26.8 | 135 | 69  | 23.23 | 3.09 |
| 25 | B14168E-MR-27 | 118.2  | 10 | 83 | 105 | 23.8 | 112 | 51  | 23.60 | 3.99 |
|    | BP 30524-SKI-2-1 | 141.9  | 11 | 78 | 100 | 27.4 | 136 | 40  | 24.19 | 4.00 |
| 26 | BP 30524-SKI-2-2 | 120.0  | 11 | 83 | 105 | 25.6 | 127 | 30  | 24.65 | 4.00 |
|    | BP 30524-SKI-2-3 | 120.0  | 7  | 79 | 101 | 25.6 | 120 | 34  | 25.23 | 3.93 |
| 27 | B15150E-MR-32 | 109.2  | 10 | 75 | 97  | 25.9 | 90  | 95  | 23.66 | 2.47 |
|    | B15150E-MR-50 | 111.6  | 9  | 76 | 98  | 24.4 | 91  | 44  | 24.07 | 4.04 |
| 28 | B15151E-MR-21 | 113.7  | 9  | 75 | 97  | 27.4 | 137 | 31  | 24.66 | 3.28 |
|    | B15151E-MR-45 | 107.3  | 10 | 75 | 97  | 27.0 | 88  | 29  | 23.82 | 4.38 |
| 29 | B13612G-TB-3 | 125.1  | 9  | 75 | 97  | 26.1 | 69  | 86  | 25.72 | 2.90 |
|    | B15053F-PWR-10 | 113.9  | 8  | 79 | 101 | 25.8 | 126 | 106 | 25.01 | 3.16 |
| 30 | B15203B-MR-1-Blk-11 | 132.0  | 11 | 84 | 106 | 28.2 | 146 | 50  | 23.17 | 3.00 |
|    | B15203B-MR-1-Blk-45 | 126.4  | 9  | 80 | 102 | 28.7 | 176 | 52  | 25.70 | 5.58 |
| 31 | B15203B-MR-1-Blk-49 | 123.3  | 11 | 79 | 101 | 29.0 | 145 | 74  | 25.94 | 5.45 |
|    | BP30483c-SKI-5-3-3-3-1 | 85.1   | 8  | 75 | 97  | 24.8 | 102 | 65  | 26.46 | 1.13 |
| 32 | BP30483c-SKI-5-3-3-2 | 93.8   | 6  | 75 | 97  | 24.7 | 91  | 56  | 26.57 | 0.84 |
|    | B15198B-MR-1-1-Ski-7 | 131.6  | 9  | 75 | 97  | 24.3 | 94  | 21  | 25.34 | 2.58 |
| 33 | B15862-6-1-Ski-2 | 74.1   | 9  | 81 | 103 | 21.8 | 58  | 39  | 27.11 | 1.29 |
|    | B15200E-MR-25 | 105.6  | 10 | 76 | 98  | 25.8 | 120 | 43  | 24.69 | 5.25 |
| 34 | B15478D-MR-21 | 118.9  | 9  | 77 | 99  | 24.8 | 111 | 55  | 24.25 | 3.54 |
|    | B15478D-MR-22 | 121.3  | 8  | 80 | 102 | 24.3 | 109 | 48  | 24.13 | 4.78 |
| 35 | B15562D-MR-20 | 101.7  | 10 | 80 | 102 | 25.6 | 123 | 28  | 24.12 | 5.69 |
|    | B15562D-MR-36 | 124.8  | 10 | 77 | 99  | 26.0 | 100 | 73  | 25.70 | 3.56 |
| 36 | B15406E-KR-17 | 107.2  | 11 | 84 | 105 | 26.2 | 116 | 62  | 22.98 | 4.47 |
|    | B15494D-KR-16 | 133.6  | 11 | 78 | 100 | 24.8 | 117 | 49  | 24.30 | 5.23 |
| 37 | B15511D-KR-30 | 123.8  | 10 | 79 | 101 | 27.4 | 139 | 51  | 27.00 | 5.38 |
Table 2. Grain quality of upland rice lines

| NO | Genotype          | Head (%) | Yield (%) | Amylose (%) | Rice texture | Size |
|----|-------------------|----------|-----------|-------------|--------------|------|
| 1  | B15150E-MR-11     | 57       | 52        | 21.07       | 2.0          | tender | L    | M    | M    |
| 2  | B14986E-MR-26     | 69       | 50        | 19.11       | 2.1          | tender | L    | M    | M    |
| 3  | B14987E-MR-27     | 57       | 53        | 23.10       | 3.2          | tender | medium | L | M | M |
| 4  | B15151E-MR-23     | 65       | 51        | 22.40       | 3.0          | medium | L | M | M |
| 5  | B15151E-MR-21     | 57       | 51        | 22.19       | 2.8          | medium | L | M | M |
| 6  | B14986E-MR-10     | 73       | 60        | 22.12       | 2.8          | medium | L | M | M |
| 7  | B15151E-MR-18     | 51       | 55        | 21.98       | 3.0          | tender | L | M | S |
| No. | Sample ID          | Width | Length | Degree of Motion | Texture  |
|-----|--------------------|-------|--------|-----------------|----------|
| 8   | B15150E-MR-50      | 45    | 46     | 23.38           | 2.8      | medium | L M M |
| 9   | B15340-2B-TB-23    | 41    | 57     | 22.75           | 2.7      | medium | L M M |
| 10  | B15154E-MR-2       | 44    | 53     | 22.89           | 2.8      | medium | L M M |
| 11  | B14987E-MR-17      | 60    | 43     | 19.67           | 2.1      | tender  | L M S |
| 12  | B15151E-MR-1       | 51    | 51     | 22.33           | 3.1      | medium | L M M |
| 13  | B15151E-MR-13      | 50    | 53     | 21.70           | 2.5      | tender  | L M M |
| 14  | B13017B-RS*-1-2-6-PN-11-2-1 | 59 | 48 | 17.15 | 2.1 | tender | L M M |
| 15  | B15197B-MR-2-Blk-22 | 77    | 54     | 21.70           | 2.2      | tender  | L M M |
| 16  | B14171F-MR-1       | 56    | 50     | 20.72           | 2.1      | tender  | L M M |
| 17  | B15201B-MR-1-Blk-20 | 56    | 61     | 19.95           | 2.1      | tender  | L M M |
| 18  | B15119C-TB-47      | 45    | 66     | 22.12           | 2.8      | medium | L M M |
| 19  | B15119C-TB-24      | 42    | 59     | 17.36           | 2.1      | tender  | L M M |
| 20  | B13017B-RS*-1-2-6-PN-10-5-5 | 48 | 42 | 18.76 | 2.1 | tender | L M M |
| 21  | B12743-MR-18-2-3-5-PN-10-3-1 | 43 | 53 | 17.43 | 2.1 | tender | L M M |
| 22  | B12743-MR-18-2-3-2-PN-1-1-1 | 42 | 41 | 18.90 | 2.0 | tender | L M S |
| 23  | BP 30524D-SKI-3-3  | 52    | 42     | 16.59           | 2.0      | tender  | L M S |
| 24  | B15119C-TB-43      | 20    | 51     | 21.49           | 2.4      | medium | L M M |
| 25  | B15186C-TGB-43     | 33    | 48     | 23.17           | 3.3      | medium | L M M |
| 26  | B14168E-MR-28      | 37    | 40     | 27.02           | 4.0      | hard    | L M S |
| 27  | B13498D-9          | 32    | 58     | 18.90           | 2.1      | tender  | L M M |
| 28  | B15198D-MR-1-2     | 21    | 48     | 21.07           | 2.1      | tender  | M M M |
| 29  | B15344B-TB-4       | 30    | 41     | 24.15           | 3.4      | medium  | L M M |
| 30  | B15344B-TB-31      | 26    | 39     | 23.94           | 3.2      | medium  | M M M |
| 31  | B15122C-TB-12      | 33    | 46     | 23.31           | 3.2      | medium  | M M S |
| 32  | B15120C-TB-42      | 35    | 54     | 21.70           | 2.5      | tender  | L M M |
| 33  | B14168E-MR-27      | 54    | 49     | 26.67           | 3.8      | hard    | L M M |
| 34  | BP 30524D-SKI-2-1  | 28    | 49     | 22.40           | 2.8      | medium  | L M S |
| 35  | BP 30524D-SKI-2-2  | 43    | 56     | 16.52           | 2.1      | tender  | L M S |
| 36  | BP 30524D-SKI-2-3  | 47    | 47     | 21.07           | 2.1      | tender  | L M S |
| 37  | B15150E-MR-32      | 47    | 48     | 23.24           | 3.2      | medium  | L M S |
| 38  | B15150E-MR-50      | 52    | 48     | 23.24           | 3.2      | medium  | L M S |
| 39  | B15151E-MR-21      | 47    | 47     | 21.07           | 2.1      | tender  | L M S |
| 40  | B15151E-MR-45      | 47    | 47     | 21.07           | 2.1      | tender  | L M S |
| 41  | B13612G-TB-3       | 58    | 55     | 21.56           | 2.1      | tender  | L M M |
| 42  | B15053F-PWR-10     | 47    | 47     | 21.07           | 2.1      | tender  | L M M |
| 43  | B15203B-MR-1-Blk-11| 52    | 53     | 20.09           | 2.0      | tender  | L M M |
| 44  | B15203B-MR-1-Blk-45| 54    | 50     | 20.09           | 2.0      | tender  | L M M |
| 45  | B15203B-MR-1-Blk-49| 45    | 42     | 21.63           | 2.5      | tender  | L M M |
| 46  | BP 30483c-SKI-5-3-3-1 | 45 | 42 | 21.63 | 2.5 | tender | L M M |
| 47  | BP 30483c-SKI-5-3-3-2 | 65 | 49 | 20.16 | 2.2 | tender | L M M |
4. Conclusion
The preliminary yield test activity obtained ten lines which showed higher yields than the best comparison varieties (Inpago 12). The lines are B14986E-MR-26 (6.78 ton/ha), B15151E-MR-23 (6.39 ton/ha), B15151E-MR-21 (6.61 ton/ha), B15151E-MR-18 (5.95 ton/ha), B15340-2B-TB-23 (5.87 ton/ha), B15154E-MR-2 (6.33 ton/ha), B15151E-MR-1 (5.78 ton/ha), B13017B-RS * 1-2-6 -PN-11-2-1 (5.94 ton/ha), B14168E-MR-28 (5.76 ton/ha), B13498D-9 (5.62 ton/ha), B15198B-MR-1-2 (5.63 ton/ha), B15562D-MR-20 (5.69 ton/ha), and B15511D-KR-31 (6.32 ton/ha). The amylose content of the strains tested were mostly low and medium with long appearance and liming rice was LMM.

References
[1] Hairmansis A, Yullianida, Supartopo, Suwarno. 2016. Pemuliaan padi gogo adaptif pada lahan kering. IPTEK Tanaman Pangan 11(2): 95-106
[2] Fagi A M Toha H.M., Baharsyah J.S. 2004. Potensi padi gogo dalam swasembada beras. Dalam. Kasryno F. Pasandaran E. Fagi A.M. (Eds). Ekonomi Padi dan Beras Indonesia. Badan Penelitian dan Pengembangan Pertanian. Jakarta. Hal. 347-372
[3] Toha H M, K. Pirngadi, K. Permadi, A.M. Fagi. 2009. Meningkatkan dan memantapkan produktivitas dan produksi padi gogo. Dalam: A.A. Daradjat, A. Setyono, A.K. Makarim, A. Hasanuddin (Ed). Padi Inovasi Teknologi Produksi Buku 2. LIPI Press. Jakarta
[4] Toha H M. 2012. Pengembangan padi gogo mengatasi rawan pangan wilayah marginal. Dalam. Dariah A., Kartiwa B., Sutrisno N., Suradisastra K., Sarwani M., Soeparno H., Pasandaran E. Prospek Pertanian Lahan Kering dalam Mendukung Ketahanan Pangan. Balitbangtan. Jakarta Hal. 143-163
[5] Rochayati S. dan Dariah A. 2012. Pengembangan lahan kering masam: Peluang, tantangan dan strategi, serta teknologi pengelolaan. Dalam. Dariah A., Kartiwa B., Sutrisno N.,
Suradisastra K., Sarwani M., Soeparno H., Pasandaran E. (Ed) Prospek Pertanian Lahan Kering dalam Mendukung Ketahanan Pangan. Balitbangtan. Jakarta Hal. 187-204

[6] Sasmita P, Suprihanto, Y. Nugraha, I. Hasmi, Satoto, I.A. Rumanti, Z. Susanti, B. Kusbiantoro, Rahmini, A. Hairmansis, T. Sitaresmi, Suharna, M. Norvyani, dan D. Arismia. 2020. Deskripsi Varietas Unggul Padi. Badan Penelitian dan Pengembangan Pertanian, Kementerian Pertanian.

[7] Sasmita, P. and Y. Nugraha. 2020. Rice Breeding Strategy for Climate Resilience and Value Addition in Indonesia. Strategies and Technologies for the Utilization and Improvement of Rice. Puji Lestari, Karden Mulya, Dwinita Wikan Utami, Dani Satyawan, Supriadi, Mastur (eds). Jakarta: IAARD Press, 2020.

[8] Custodio, M.C., R.P. Cuevas, J. Ynion, A. G. Laborte, M. L. Velasco, and M. Demont. 2019. Rice quality: How is it defined by consumers, industry, food scientists, and geneticists?. Trends in Food Science & Technology 92:122-137.

[9] Anang, B.T., S.N.A. Adjete, and S.A. Abiriwie. 2011. Consumer preferences for rice quality characteristics and the effects on price in the Tamale Metropolis, Northern Region, Ghana. International Journal of AgriScience 1(2): 67-74.

[10] D.K.S. Swastika 2012 The role of post-harvest handling on rice quality in Indonesia. Forum Penelitian Agro Ekonomi 30(1):1-11.