

Barley Seed Growth, Development and Their Protein Accumulation Produced under Irrigated Northern Thailand

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Abstract

Growth of seed development and crude protein content accumulation of two barley varieties, BRB. 2 and BRB. 9, was investigated at the Agronomy Department, Chiang Mai University. The experiment was arranged in Randomized Complete Block design with 3 replication. Samples were taken at every two days interval after flowering. Seed moisture content, seed dry weight, seed size, germination percentage, seed vigor index, crude protein content and changes of glume color were determinate and investigated. BRB. 2 has been found its physiological maturity at 34 days after flowering, 100 seed dry weight was 4.37 gm., seed moisture content was 10.99%, seed size were 10.11 mm., 3.40 mm. and 2.59 mm. in length, width and thickness, respectively. Seed germination was 90.25%, seed vigor index was 16.41 and seedling dry weight was 39.31 mg./plant/day, besides that the physiological maturity of the variety, BRB. 9 was 28 days after flowering, 100 seed weight was 4.71 gm., seed moisture content was 13.57% seed size were 9.87 mm., 3.73 mm. and 2.70 mm. in length, width and thickness, respectively. Seed germination was 92.58%, seed vigor index was 13.28 and seedling dry weight was 45.69 mg./plant/day. According to Munsell color chart, glume color were compared, it was found that at physiological maturity both varieties were yellow-green at the level of 2.8 GY 8/8. Crude protein content of BRB. 2 and BRB. 9 were highest accumulated (12.04%) at 34 days after flowering and (9.61%) at 26 days after flowering, respectively.

Keywords: Seed Growth, Seed Protein Accumulation, Seed Development

Introduction

Spring type of barley usually grows in the northern and some part of northeastern Thailand. One of the production constraints is good quality seed. The old varieties; Sameang 1, Sameang 2 and BRB. 2 usually provided low yield and quality and required particular environment factor. The new variety BRB. 9 which recommended as a good variety with its large seed size, low protein content (11-14 %) and short planting time (Brumer, 1990). However, the information about seed development are very few. Therefore it is necessary to investigate the optimization of its growth and development in order to contribute these information for further research and also seed production in commercial scale.

Materials and methods

The experiment was conducted and arranged in RCB design with 3 replications. Samples were taken at every two days interval after flowering. The following informations are investigated and collected.

Pattern of seed dry matter accumulation

100 seeds were dried at 100° C for 48 hrs. Dryweight were recorded.

Relationship between stage of seed development and seed quality

seed moisture content determination by Air oven method (ISTA, 1985)

standard germination test by ISTA (1985)

vigor index and seedling dry weight determination (ISTA, 1985)

Indication of seed alteration after flowering to maturation

seed size measurement

glume color compared with Munsell color charts

Protein content of seed alteration

crude protein content determination by Standard Kjeldahl method (1960)

Statistical analysis

Analyze the variance and compare the difference of treatment by Least Significant Different (LSD). The relationship between stage of development, seed dry matter, seed size, crude protein content and seed quality after flowering until physiological maturity are investigated by correlation and regression analysis.(Steel and Torrie,1960)

Result

Seed growth, development and crude protein accumulate of two barleys were determined and analyzed. It was found that seed dry matter, crude protein content and seed sizes were positive correlated with stage of seed development. Seed moisture content was contrastly correlated. The development of seed dry matter and seed size were highly positive correlated with germination percentage and seed vigor. BRB. 2 has been found that its physiological maturity(PM) was 34 day after flowering(DAF) and its harvesting time was 100 days after planting (DAP). Beside that the PM of BRB9 was 28 DAF and its harvesting time was 67 DAP. Glume's color could be used as the visual indicator of its PM. At PM, glume's color were yellow - green. Malting industrial production need high quality seed with low protein content(9-11.5 %). Therefore, the optimum harvesting time for malting production of BRB.2 and BRB.9 should be at their PM which were 34 and 28 DAF, respectively.

Conclusion

BRB. 2 has been found its physiological maturity at 34 days after flowering, 100 seed dry weight was 4.37 gm., seed moisture content was 10.99%, seed size were 10.11 mm., 3.40 mm. and 2.59 mm. in length, width and thickness, respectively. Seed germination was 90.25%, seed vigor index was 16.41 and seedling dry weight was 39.31 mg./plant/day, the

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Table 1. Seed moisture content, 100 seed dry weight, seed size, protein content, germination percentage and seed vigor of BRB. 2

| DAF (day) | seed mc. (%) | 100 seed dry weight (g.) | seed length (mm.) | seed width (mm.) | seed thickness (mm.) | seed protein content (%) | seed germ. (%) | seed Vigor index | seedling dry weight (mg./plant) |
|----------------|--------------------|-----------------------------------|-------------------------|------------------------|----------------------------|-----------------------------------|----------------------|------------------------|--|
| 2 | 75.81 | 0.60 | 9.61 | 2.17 | 1.16 | 2.34 | 0.0 | 0.0 | 0.0 |
| 4 | 71.45 | 0.74 | 9.71 | 2.26 | 1.26 | 2.52 | 0.0 | 0.0 | 0.0 |
| 6 | 70.35 | 0.87 | 9.87 | 2.42 | 1.30 | 3.16 | 0.5 | 0.0 | 0.0 |
| 8 | 69.80 | 1.37 | 10.01 | 2.59 | 1.52 | 3.84 | 0.67 | 0.0 | 0.0 |
| 10 | 66.22 | 1.79 | 10.11 | 2.79 | 1.68 | 4.26 | 1.17 | 0.0 | 0.0 |
| 12 | 64.07 | 2.15 | 10.15 | 2.83 | 1.84 | 4.64 | 5.42 | 1.14 | 0.0 |
| 14 | 62.60 | 2.32 | 10.22 | 2.87 | 1.85 | 5.62 | 7.00 | 2.22 | 0.0 |
| 16 | 60.63 | 2.77 | 10.29 | 2.96 | 2.04 | 5.85 | 12.50 | 3.13 | 2.08 |
| 18 | 59.35 | 3.18 | 10.27 | 3.00 | 2.11 | 7.26 | 13.67 | 4.00 | 7.68 |
| 20 | 48.55 | 3.49 | 10.28 | 3.13 | 2.25 | 8.29 | 23.17 | 6.30 | 9.33 |
| 22 | 43.33 | 3.81 | 10.26 | 3.20 | 2.37 | 8.45 | 42.92 | 8.76 | 17.56 |
| 24 | 28.00 | 3.98 | 10.25 | 3.26 | 2.45 | 8.64 | 59.25 | 9.71 | 20.42 |
| 26 | 22.29 | 4.03 | 10.24 | 3.30 | 2.57 | 8.81 | 78.00 | 10.37 | 22.27 |
| 28 | 15.50 | 4.14 | 10.25 | 3.40 | 2.59 | 8.97 | 78.58 | 11.51 | 24.74 |
| 30 | 12.02 | 4.21 | 10.22 | 3.36 | 2.60 | 10.26 | 82.92 | 12.35 | 28.60 |
| 32 | 11.67 | 4.24 | 10.23 | 3.37 | 2.62 | 11.87 | 88.83 | 14.53 | 32.18 |
| 34 | 10.99 | 4.37 | 10.28 | 3.42 | 2.67 | 12.04 | 90.25 | 16.41 | 39.31 |
| 36 | 7.50 | 4.29 | 10.24 | 3.39 | 2.65 | 12.04 | 86.67 | 15.53 | 27.23 |
| 38 | 7.42 | 4.27 | 10.27 | 3.41 | 2.63 | 12.00 | 73.42 | 15.03 | 26.80 |
| 40 | 6.04 | 4.25 | 10.25 | 3.42 | 2.74 | 12.07 | 59.58 | 13.11 | 24.91 |
| <hr/> | | | | | | | | | |
| LSD(5%) | 5.69 | 0.10 | 0.32 | 0.12 | 0.12 | 0.65 | 5.47 | 1.11 | 3.78 |
| LSD(5%) | 5.69 | 0.10 | 0.32 | 0.12 | 0.12 | 0.65 | 5.47 | 1.11 | 3.78 |
| CV(%) | 8.54 | 2.02 | 1.91 | 2.39 | 3.50 | 5.23 | 7.92 | 9.25 | 13.65 |
| F test | 184.45** | 1451.31** | 3.21** | 95.15** | 150.9** | 207.43** | 397.56** | 252.18** | 73.77** |

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Table 2. Seed moisture content, 100 seed dry weight, seed size, protein content, germination percentage and seed vigor of BRB. 9

| DAF (day) | seed mc. (%) | 100 seed dry weight (g.) | seed length (mm.) | seed width (mm.) | seed thickness (mm.) | seed protein content (%) | seed germ. (%) | seed Vigor index | seedling dry weight (mg./plant) |
|----------------|--------------------|-----------------------------------|-------------------------|------------------------|----------------------------|-----------------------------------|----------------------|------------------------|--|
| 2 | 79.42 | 0.50 | 9.76 | 1.89 | 0.82 | 1.68 | 0.0 | 0.0 | 0.0 |
| 4 | 75.40 | 0.71 | 9.80 | 2.67 | 1.32 | 1.82 | 0.0 | 0.0 | 0.0 |
| 6 | 73.08 | 0.96 | 9.87 | 2.99 | 1.77 | 2.27 | 0.58 | 0.0 | 0.0 |
| 8 | 68.97 | 1.57 | 9.90 | 3.05 | 1.83 | 3.81 | 0.75 | 0.0 | 0.0 |
| 10 | 65.73 | 1.90 | 9.97 | 3.06 | 1.95 | 3.98 | 3.58 | 0.96 | 0.0 |
| 12 | 61.34 | 2.44 | 9.97 | 3.12 | 1.99 | 4.32 | 6.69 | 2.43 | 0.0 |
| 14 | 57.82 | 2.98 | 10.08 | 3.28 | 2.19 | 5.46 | 12.50 | 3.70 | 2.90 |
| 16 | 54.54 | 3.43 | 10.11 | 3.49 | 2.49 | 6.25 | 12.92 | 4.63 | 4.17 |
| 18 | 51.83 | 3.66 | 10.09 | 3.58 | 2.57 | 7.22 | 13.17 | 5.87 | 20.90 |
| 20 | 47.97 | 3.92 | 10.08 | 3.60 | 2.60 | 7.58 | 14.08 | 6.86 | 27.67 |
| 22 | 44.33 | 4.42 | 10.07 | 3.66 | 2.64 | 8.64 | 26.58 | 7.83 | 32.64 |
| 24 | 35.00 | 4.50 | 10.08 | 3.67 | 2.70 | 8.70 | 49.58 | 9.82 | 37.53 |
| 26 | 27.10 | 4.59 | 10.10 | 3.70 | 2.74 | 9.61 | 68.83 | 11.88 | 39.09 |
| 28 | 13.57 | 4.71 | 10.10 | 3.73 | 2.78 | 10.52 | 92.58 | 13.28 | 45.69 |
| 30 | 13.11 | 4.67 | 10.09 | 3.74 | 2.83 | 9.91 | 89.08 | 11.01 | 38.39 |
| 32 | 12.45 | 4.60 | 10.08 | 3.76 | 2.82 | 10.46 | 88.67 | 9.75 | 37.03 |
| 34 | 12.08 | 4.58 | 10.08 | 3.77 | 2.84 | 9.82 | 88.00 | 9.66 | 35.88 |
| 36 | 11.25 | 4.55 | 10.10 | 3.82 | 2.85 | 9.64 | 80.67 | 9.93 | 34.24 |
| 38 | 9.08 | 4.59 | 10.08 | 3.85 | 2.83 | 9.37 | 60.00 | 9.65 | 34.27 |
| 40 | 8.08 | 4.56 | 10.08 | 3.84 | 2.08 | 9.93 | 58.42 | 8.47 | 35.03 |
| LSD(1%) | 2.97 | 0.19 | 0.28 | 0.13 | 0.18 | 1.14 | 5.07 | 0.65 | 7.14 |
| LSD(5%) | 2.22 | 0.14 | 0.20 | 0.10 | 0.13 | 0.84 | 3.79 | 0.87 | 5.33 |
| CV(%) | 3.26 | 2.56 | 1.23 | 1.77 | 3.34 | 7.32 | 5.62 | 6.27 | 14.88 |
| F test | 1106.22** | 892.15** | 2.24* | 200.5** | 162.18** | 107.54** | 843.03** | 387.42** | 97.55** |

Table 3. Correlation between seed dry matter accumulation, seed size and seed quality of BRB.2

| | seed dry matter | seed length | seed width | seed thickness | seed germ. | seed vigor index | seedling dry weight |
|---------------------|-----------------------|----------------|---------------|-------------------|---------------|------------------------|---------------------------|
| seed dry matter | | | | | | | |
| seed length | 0.83** | | | | | | |
| seed width | 0.99** | 0.87** | | | | | |
| seed thickness | 0.99** | 0.82** | 0.99** | | | | |
| seed germ. | 0.90** | 0.56* | 0.88** | 0.89** | | | |
| seed vigor index | 0.93** | 0.61** | 0.90** | 0.94** | | | |
| seedling dry weight | 0.89** | 0.55** | 0.86** | 0.89** | | | |

*,** = significant at 95 % and 99% ,respectively

Table 4. Correlation between seed dry matter accumulation, seed size and seed quality of BRB.9

| | seed dry matter | seed length | seed width | seed thickness | seed germ. | seed vigor index | seedling dry weight |
|---------------------|-----------------------|----------------|---------------|-------------------|---------------|------------------------|---------------------------|
| seed dry matter | | | | | | | |
| seed length | 0.93** | | | | | | |
| seed width | 0.93** | 0.93** | | | | | |
| seed thickness | 0.97** | 0.95** | 0.99** | | | | |
| seed germ. | 0.82** | 0.63** | 0.73** | 0.77** | | | |
| seed vigor index | 0.96** | 0.82** | 0.84** | 0.88** | | | |
| seedling dry weight | 0.90** | 0.71** | 0.79** | 0.83** | | | |

*,** = significant at 95 % and 99% ,respectively