UNIVERSITI PUTRA MALAYSIA

IMPROVEMENT OF SEEDLING ESTABLISHMENT AND LODGING RESISTANCE IN SELECTED RICE CULTIVARS USING GROWTH REGULATORS

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IMPROVEMENT OF SEEDLING ESTABLISHMENT AND LODGING RESISTANCE IN SELECTED RICE CULTIVARS USING GROWTH REGULATORS

By

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Studies were conducted to investigate the possible use of growth regulators to improve seedling establishment and lodging resistance in wet seeded rice cultivars.

The first experiment was designed to evaluate the effect of growth regulators i.e. GA_3 and IBA as seed treatment on seedling establishment, growth and grain yield. Levels of GA_3 were 25, 50 and 100 mg/L and IBA were 10, 20 and 40 mg/L; and water was used as control. The treatments were tested on four rice cultivars i.e. Membramo and Widas (Indonesian cultivars), MR 219 and MR 84 (Malaysian cultivars). In the second experiment, growth retardants paclobutrazol and prohexadione calcium at 50, 100 and 200 mg/L as foliar application at panicle initiation were investigated for their effects on growth, lodging resistance and yield of four rice cultivars. A third experiment was conducted to evaluate selected

combinations of seed treatment and foliar spray on growth, lodging resistance and yield of two rice cultivars.

Results of the study showed that GA_3 as seed treatment induced favourable early emergence but shoot etiolation resulted in seedlings more prone to lodging during the vegetative phase. On the other hand, IBA treatments improved root growth by increasing the number of adventitious roots and contributed towards better establishment with seedlings having broader and greener leaves. IBA at all concentrations did not show any significant differences in all growth parameters measured and had no detrimental effects on grain yield. IBA at 10 mg/L was sufficient in providing the required improvement in the rice seedlings.

Cultivar response to GA_3 was similar, however response to IBA was different. Indonesian cultivars had shoot lengths comparable to the control, while the Malaysian cultivars had shorter shoots.

Foliar applied growth retardants inhibited plant growth, retarded internode and culm length but increased culm diameter. All treated plants had higher bending and stem breaking resistance compared to the control. The treatments also improved culm thickness, increased the amount of cellulose, hemicellulose and lignin content in culms. Histological studies showed greater compaction of parenchyma cells and thickening of parenchyma cell walls. The higher bending and breaking resistance and hence improved lodging resistance was largely attributed to these changes in culms treated with the growth retardants.

Treatments with 100 and 200 mg/L paclobutrazol and prohexadione gave significant retardation of internodes, reduced culm length by 20% and gave higher stem breaking resistance compared to those at 50 mg/L, but did not affect yield. High concentration of retardant can suppress effective panicle exertion, as such 100 mg/L paclobutrazol is recommended as paclobutrazol is more cost-effective compared to prohexadione calcium.

Cultivar response to growth retardants was similar. The differences amongst cultivars in parameters observed are attributed to their genetic differences. In general, Malaysian cultivars had larger culm diameter with higher bending and stem breaking resistance compared to Indonesian cultivars. Indonesian cultivars had shorter plant height and higher tiller numbers compared to Malaysian cultivars.

Combinations of seed treatment with IBA and foliar application of paclobutrazol at panicle initiation gave similar response as with individual chemicals. IBA improved rooting ability at the early stage and paclobutrazol retarded internodes and improved stem breaking resistance. Plants treated with 100 and 200 mg/L paclobutrazol alone or in combination with 10 mg/L IBA had significantly higher stem breaking resistance and pulling down resistance compared to the control or IBA alone. There were no significant differences in grain yield.

The results indicate that seed treatment with IBA followed by paclobutrazol at panicle initiation significantly improved lodging resistance without any detrimental effects on tillering, photosynthetic rate, yield components or grain yield. With significant reductions in yield losses due to lodging, the direct benefit to farmers is the increase in harvestable yields.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Master Sains Pertanian

PENINGKATAN KEUPAYAAN ANAK BENIH DAN KETAHANAN REBAH PADA KULTIVAR PADI TERPILIH DENGAN MENGGUNAKAN PENGAWALATUR TUMBESARAN

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Kajian telah dijalankan untuk mengetahui kesan penggunaan pengawalatur tumbesaran untuk meningkatkan keupayaan anak benih dan ketahanan terhadap kerebahan tanaman padi menggunakan sistem tabur terus.

Eksperimen pertama mengkaji kesan pengawalatur tumbesaran iaitu GA_3 dan IBA menggunakan kaedah rawatan biji benih ke atas perkembangan anak benih, tumbesaran dan hasil padi. Kepekatan GA_3 yang digunakan ialah 25, 50 dan 100 mg/L dan IBA pada 10, 20 dan 40 mg/L dengan air sebagai rawatan kawalan. Empat kultivar padi iaitu Membramo dan Widas (kultivar dari Indonesia), MR 219 dan MR 84 (kultivar dari Malaysia) digunakan dalam kajian ini. Ekperimen kedua pula dijalankan untuk mengkaji kesan perencat tumbesaran paclobutrazol dan prohexadione calcium pada kadar 50, 100 dan 200 mg/L ke atas tumbesaran, ketahanan terhadap rebah dan hasil padi. Empat kultivar seperti yang digunakan dalam eksperimen satu diuji dan aplikasi adalah secara semburan daun semasa

pembentukan panikal. Eksperimen ketiga dijalankan untuk mengkaji kesan kombinasi rawatan biji benih dan semburan daun ke atas tumbesaran, ketahanan terhadap rebah dan hasil padi. Rawatan melibatkan kombinasi terpilih dari eksperimen satu dan dua dan dikaji pada dua kultivar padi.

Rawatan GA_3 mempercepatkan kemunculan anak benih, akan tetapi pucuknya mengalami etiolasi dan mengakibatkan anak benih mudah rebah semasa perkembangan vegetatif. Sebaliknya, rawatan IBA menggalakkan pengakaran dengan meningkatkan jumlah akar adventitus dan menyumbang terhadap tumbesaran anak benih yang lebih sihat dengan daun yang lebih lebar dan hijau. Kepekatan IBA yang berbeza tidak memberikan kesan yang bererti ke atas parameter pertumbuhan dan tiada kesan negatif ke atas hasil. IBA pada kepekatan 10 mg/L adalah cukup untuk memberikan kesan positif ke atas anak benih padi.

Kesan kultivar ke atas aplikasi GA_3 adalah sama, tetapi kesan IBA berbeza, dimana pemanjangan pucuk kultivar dari Indonesia adalah setanding dengan kawalan, manakala kultivar dari Malaysia mempunyai pucuk yang lebih pendek.

Perencat tumbesaran pula merencat perkembangan pokok, internod dan batang padi tetapi meningkatkan garispusat batang. Semua pokok padi yang dirawat dengan perencat tumbesaran mempunyai ketahanan rebah yang lebih tinggi berbanding dengan kawalan. Ketebalan batang, kandungan total selulosa, hemiselulosa dan lignin pada batang padi juga meningkat. Kajian histologi menunjukkan pemadatan pada sel parenkima dan peningkatan ketebalan dinding sel parenkima. Peningkatan pada struktur batang ini memberikan peningkatan terhadap ketahanan rebah.

Rawatan paclobutrazol dan prohexadione calcium pada kepekatan 100 dan 200 mg/L menunjukkan kesan pemendekan yang bererti pada internod dimana pemendekan batang sebanyak 20% diperolehi dan juga meningkatkan ketahanan rebah tanpa mempengaruhi hasil berbanding dengan rawatan pada kepekatan 50 mg/L. Kepekatan perencat yang tinggi boleh mempengaruhi kebolehan padi untuk terbit, jadi paclobutrazol pada kepekatan 100 mg/L disyorkan berbanding dengan prohexadione calcium memandangkan paclobutrazol adalah lebih murah.

Kesan kultivar keatas perencat tumbesaran adalah sama tetapi wujud perbezaan antara kultivar yang kemungkinannya disebabkan oleh perbezaan genetik. Secara amnya, kultivar dari Malaysia mempunyai garispusat batang yang lebih besar dengan ketahanan rebah yang lebih tinggi berbanding dengan kultivar dari Indonesia. Sedangkan kultivar dari Indonesia mempunyai batang yang lebih pendek dan jumlah anak pokok yang lebih banyak.

Kombinasi rawatan IBA dan paclobutrazol memberikan kesan yang sama seperti yang diperolehi apabila rawatan diberikan secara berasingan. IBA menggalakkan pengakaran pada peringkat awal tumbesaran dan paclobutrazol merencat internod dan meningkatkan ketahanan terhadap rebah tanpa memberi sebarang kesan yang bererti ke atas hasil padi. Padi yang diberi rawatan dengan 100 mg/L paclobutrazol sahaja atau dengan kombinasi 10 mg/L IBA mempunyai ketahanan terhadap kerebahan yang lebih tinggi berbanding dengan kawalan atau rawatan dengan IBA sahaja.

Keputusan menunjukkan bahawa rawatan biji benih dengan IBA diikuti dengan paclobutrazol semasa pembentukan panikal meningkatkan ketahanan terhadap rebah tanpa sebarang kesan yang negatif ke atas jumlah anak pokok, kadar fotosintesis, komponen hasil dan hasil padi. Pengurangan kehilangan hasil akibat peningkatan ketahan rebah akan secara langsung meningkatkan hasil tuaian petani.

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