DEVELOPMENT OF P– DEFICIENCY TOLERANT INDONESIA MODERN UPLAND RICE VARIETIES USING MARKER ASSISTED BACKCROSSING

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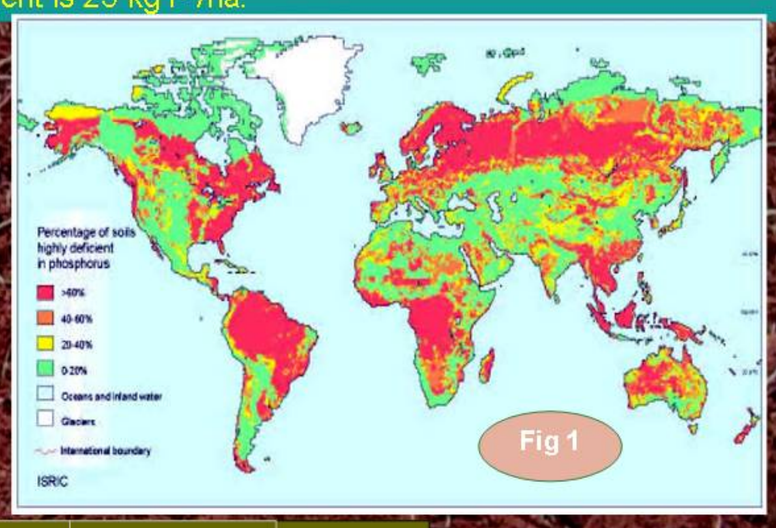
Abstract

Indonesia has 45.794.000 ha acid soils (24% of total area), mostly Ultisol and Oxisol, with high Al and P deficient. Fertilizers and amendments are too expensive for farmers, but developing varieties tolerant of P-deficiency will help solve this problem. Improved varieties tolerant to drought and Al toxicity were developed, but so far no variety with high P-deficiency tolerance is available. Developing such varieties is now feasible after the discovery of *Pup1*, a major QTL for high P-uptake from P-fixing soils. Three modern varieties (Dodokan, Situ Bagendit, Batur) were used as recipient parents and two lines (Kasalath and NIL-C443) as donors for *Pup1* QTL. Marker assisted backcrossing using foreground, recombinant, and background markers, was applied on F_1, BC_1F_1, BC_2F_1, and BC_2F_2 generations. Most of recipient parents' genome was recovered in BC_2F_1, especially with NIL-C443 crosses, and fewer loci carry the donor segments. Twenty out of 300 BC_2F_2 plants of each cross were being advanced to produce BC_2F_3 seed for field testing. Moreover, a phenotyping procedure was developed using P-deficient soil from hot spot areas. A minimal dosage of P for -P treatment in this soil is 2 kg P/ha and the optimum dosage for +P-treatment is 25 kg P /ha.

Introduction

Most of Indonesian area has a problem of P-deficiency (Fig. 1). To improve crop production, It need sensitive problem solving: to develop a new P-deficient varieties. Several improved upland rice varieties were tolerant to drought and Al toxicity had been released, yet no record for tolerant to P-deficient available.
Marker Assisted Backcrossing, especially using foreground, recombinant, and background selection, is new technology for faster development of new varieties that need BC2 or BC3 generation only
Phenotyping procedure for P deficiency in Indonesia become important, since this procedure had been used for different soil condition.
Hence, the development of rice variety that are tolerant to P- deficiency in Indonesia is mandatory .



The Objectives (2007-2008):

- To develop phenotyping procedures for P- deficiency on Indonesian acid soil
- To develop backcross population based on Marker Assisted Backcrossing analysis

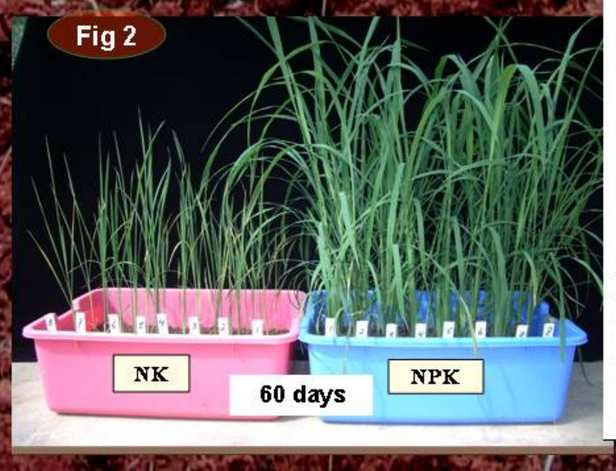
Table 1

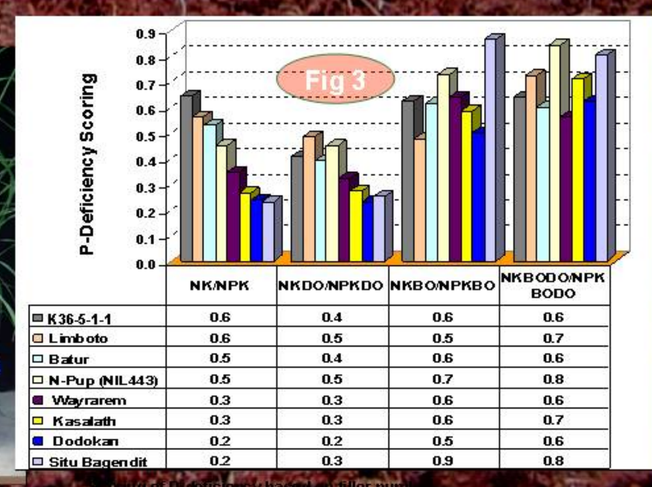
Source of soil sample	Available P2O5	Soil PH		Al Saturated (%)
		H2O (1:2.6)	KCl (1:2.5)	
Kentrong, West Java	0.7 [Bray 1 (ppm)]	4.80	3.98	65%

Research Progress (2007-2008)

1. Phenotyping procedure

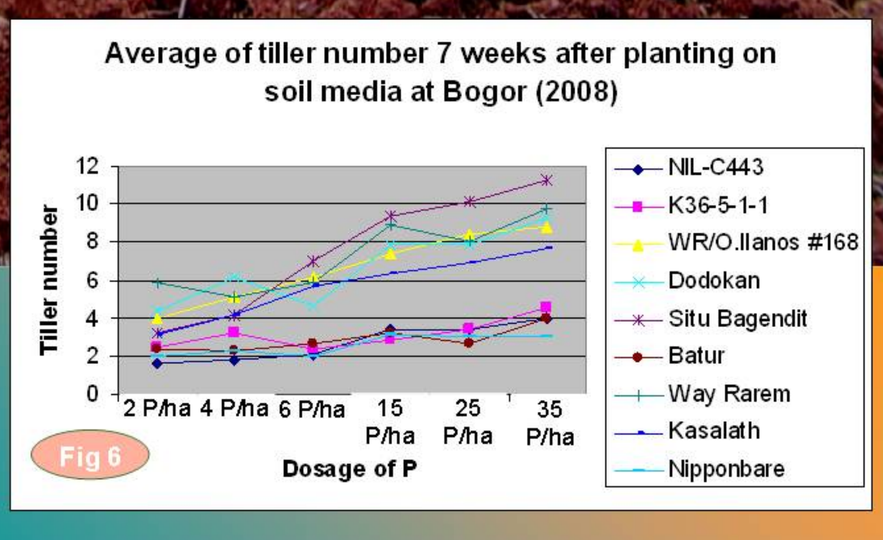
In greenhouse experiment we used soil sample from farmer's fields (Kentrong, West Java) (Table 1).
A. Effect of some additional materials to P-deficient soil was identified, such as organic manure and lime . These materials gave significant outcome on plant growth at P-deficient soil (Fig 2 and 3).
B. To verify the soil condition for testing breeding materials, a regime of P2O5 dosage were applied on greenhouse in Bogor and Sukamandi. Amount of P in Bogor were: 2, 4, 6, 15, 25 35 kg P/ha with less water treatment (Fig 4).
While amount of P in Sukamandi were 2, 4, 8, 10, 25, 45 kg P/ha with full water treatment (Fig 5).
Less water treatment indicated better condition for P treatment on soil than full water.
Dosage of P treatment for soil from Kentrong were 2 kg P/ha (minimum dosage) and 25 kg P/ha (maximum dosage) (Fig 6).





	NK/NPK	NKDO/NPKDO	NKBO/NPKBO	NKBODO/NPKBODO
K36-5-1-1	0.6	0.4	0.6	0.6
Limboto	0.6	0.5	0.5	0.7
Batur	0.5	0.4	0.6	0.6
N-Pup (NIL443)	0.5	0.5	0.7	0.8
Wayrarem	0.3	0.3	0.6	0.6
Kasalath	0.3	0.3	0.6	0.7
Dodokan	0.2	0.2	0.5	0.6
Situ Bagendit	0.2	0.3	0.9	0.8

Scoring of P-deficiency based on tiller number
Note: N=Urea ; K = KCl ; P = SP 36 ; D = Dolomit ; BO = Organic manure



2. Breeding program

Background selection analysis on 8 % poliacrylamide gel

- 1800 BC2F2 plants, derived from the best of six BC2F1 combination between modern upland Indonesian varieties (Dodokan, Situ Bagendit, Batur) and Pup-1 donor plants (Kasalath, NIL-C443), had been analyzed using specific markers for Pup-1 (Kasgene1n-C, Kasgene19-C2, Kasgene 5n-NK-C) and both for foreground and some markers for recombinant selection. Then we selected 20 plants from each crossed (total 120 plants for 6 cross combination) for future background selection using SSR primers covered 12 rice chromosome (Fig 7).
- Molecular analysis suggested that, introgression of Pup-1 segment create superior lines when crossed with NIL-C443 then that of crossed with Kasalath (Fig 8 and 9)
- BC2F2 plants, especially crossed combination with NIL-C443, suggested that improved lines phenotipically, have restored to recipient parent (Dodokan, Situ Bagendit, Batur) (Fig 10).
- Further phenotypic evaluation (field test and greenhouse test) will be conducted on BC2F3 lines.