M

Module 8.3-1 Ion exchange resins assess available phosphorus in Brazilian soils.

Soil testing is an important tool for modern agriculture. It represents a link between a remarkable amount of research information on one side and the possibility to solve many plant nutrition problems for specific farmer sites on the other. To be effective, a soil test should give adequate evaluation of soil nutrient availability. Several research studies have shown that the ion exchange resin procedure is superior to other widely used methods to determine P in routine soil testing in some Brazilian soils. Three studies here summarize the performance of this methodology. It is very possible that the same methodology can perform well in similar soils of the world (highly weathered tropical soils).

Figure 1 shows the results for a greenhouse study testing soil P availability against P uptake by 70-day-old flooded rice plants, with the eight soil samples collected from flooded soils in the state of Minas Gerais, Brazil. In this case, resin extractable P is compared with the Mehlich 1 extraction. The results of resin P presented a much better correlation with P absorbed by the rice plants than Mehlich 1.

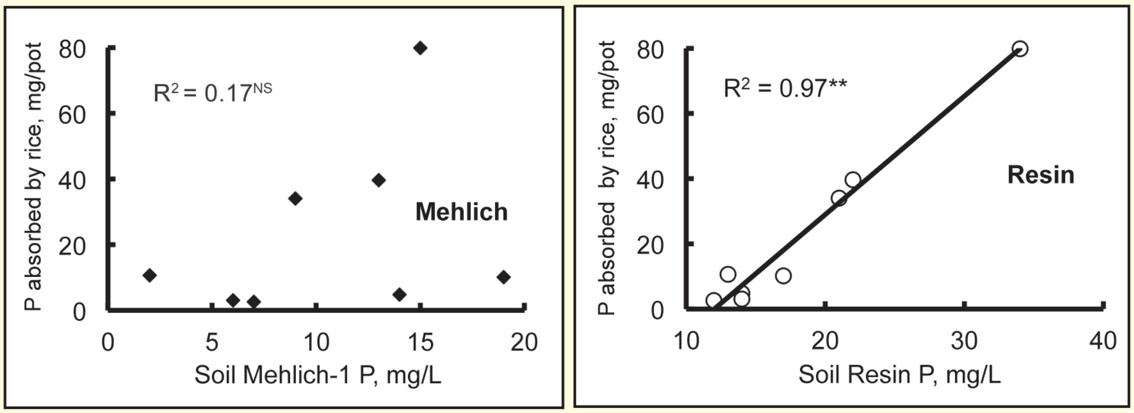

Figure 1. Relation of P uptake by flooded rice and P determined by resin and Mehlich 1 procedures (Grande et al., 1986).

In another experiment, various aspects of the relationship between fertilizer P sources and methods for soil P determination are illustrated in **Table 1.** Soils were treated with triple superphosphate (TSP), rock phosphate (RP), and calcined aluminum phosphate (CAP), applied 75 days prior to seeding. As a control for comparison, TSP was applied also at seeding time. For laboratory determinations by either resin, Mehlich 1 or Bray 1, 100 g samples of soil were incubated in the same way and with the same proportional additions, with soil analysis run three days after seeding the soybean. Phosphorus uptake by soybean was measured after 35 days.

Table 1. Phosphorus uptake by soybean, soil analysis results for the control (TSP applied at seeding) and index ratios using the control as index 100.

P evaluation	Control: TSP applied at seeding, measured value	Fertilizers applied 75 days prior to seeding		
		Triple superphosphate	Rock phosphate	Calcined aluminum phosphate
		Measured value, % of control		
Soybean uptake, mg/pot	4.3	53	27	40
Resin P, mg/L	12.7	72	11	39
Bray-1 P, mg/L	37.9	104	21	104
Mehlich-1 P, mg/L	27.9	88	153	54

Source: Raij and Diest, 1980

Comparing the results of TSP applied at seeding with those of the same fertilizer applied 75 days ahead, it can be seen that availability of P decreased with time of incubation, as shown by a 47% reduction of soybean P uptake. The decrease of P availability with time is a well-known effect. This tendency was better identified by resin than it was for Mehlich 1 or Bray 1. The indexes also show that the ion exchange resin was superior at predicting P availability to soybean plants, compared to the other methodologies, i.e. Mehlich 1 and Bray 1, when other P sources were considered. For example, CAP provided 40% of the P uptake as compared to the standard, the TSP applied at seeding. In terms of soil analysis, when the same source was applied, the resin showed 39% of P content as related to the standard, while Bray-1 and Mehlich-1 showed 104% and 54%, respectively. This implies that the ion exchange resin was more reliable in terms of predicting P availability for this source of P in the described conditions.

Another good set of information in favor of the resin methodology is given in **Table 2.** In this field experiment, various levels of lime were applied and soil pH two years after lime application was compared to soybean leaf P concentration. The results show that the resin procedure better evaluated the increase in P availability due to liming, while Mehlich 1 and Bray 1 were not sensitive to the changes caused by variation of soil pH.

Table 2. Relation between soil pH, leaf P content and soil P determined by four methods.

Crop (Location)	pH, $CaCl_2$	Leaf P, g/kg	Soil P, mg/dm³			
			Mehlich 1	Bray 1	Olsen	Resin
Soybean (Ultisol)	4.3 a	1.85 c	6 a	15 a	10 a	13 c
	4.8 d	2.06 bc	7 a	16 a	11 a	16 c
	5.5 c	2.44 ab	5 a	13 a	7 a	17 bc
	6.1 b	2.26 a	7 a	17 a	8 a	22 ab
	6.4 a	2.55 a	7 a	15 a	8 a	27 a

Source: Raij and Quaggio, 1990.

References

Grande, M.A., N. Curi, J.A. Quaggio. 1986. Revista Brasileira de Ciêrncia do Solo 10:45-50.

Raij, B. van, A. Diest, van. 1980. Plant and Soil 55:97-104.

Raij, B. van, J.A. Quaggio. 1990. Comm. Soil Sci. Plant Anal. 21(13-16):1267-1276.

Submitted by Luís Prochnow, IPNI Brazil, August 2014.