

Development of farmers' participatory integrated nutrient management technology using the Mother – Baby Trial approach

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Abstract

The Mother Baby Trial (MBT) approach is an on-farm participatory mechanism to introduce and test technology options suited to a heterogeneous community. In this study, the MBT concept was followed with integrated nutrient management (INM) technology in a soybean-wheat system. Seven treatments were tested in Mother trials in 2005-06 and 2006-07 on farmers' fields in the Rajgarh and Bhopal districts of Central India. In 2007-08, 100 Baby trials were conducted by farmers in 10 surrounding villages to demonstrate and test the INM technology. The Baby trials were based on the results of Mother trials which showed that INM using 50% of the recommended NPKS fertilizer+5 t FYM/ha+*Rhizobium* to soybean and 75% of the recommended NPKS fertilizer+P-solubilizing bacteria to wheat produced higher soybean yield by 46% and higher wheat yield by 24% over the farmers' practice. In the Baby trials, there was a wide variation in soybean yield obtained with INM, balanced fertilization (BF) using inorganic fertilizers, and farmers' practice; in poorer yielding trials, some problems were evident in the control of weeds and insect pests. Wheat responded well to BF and INM in trials irrigated 3-4 times. The MBT approach proved valuable in demonstrating higher productivity of the soybean-wheat system, and the value of INM and BF technologies, but only with proper weed and pest management in soybean, and adequate irrigation in wheat, as a package of practices.

Key Words

Integrated nutrient management, soybean-wheat system, Vertisols, mother-baby trials

Introduction

Smallholder farmers in countries such as India face a soil fertility crisis. Soil surveys in semi-arid regions have consistently shown multi-nutrient (N, P, K, S, Zn) deficiencies due to continuous cropping with limited use of nutrient inputs (Reddy *et al.* 2005). Researchers have hypothesized that currently available technologies are a poor fit with farmers' resource endowments, investment priorities and attitudes to risk. An alternative is Farmers Participatory Research to develop technologies that are better suited to smallholder conditions, and hence more readily adopted.

The Mother Baby Trial (MBT) approach is an on-farm participatory mechanism to introduce and test a range of technology options suited to a heterogeneous community (Snapp 2002). It involves three "levels" – Mother trials, Baby trials, and farmer experimentation. This approach serves multiple functions: generating data on performance of alternative technologies; creating the basis for dialogue between farmers and researchers; and encouraging subsequent experimentation by farmers even in the absence of researchers. The approach is used to help characterize farmers' risk management strategies, target technology to specific groups, and to broaden the adoption of sustainable practices.

Methods

The MBT concept was followed for developing farmers' participatory integrated nutrient management (INM) technology for a soybean-wheat system in Central India. An initial project was funded by the Australian Centre for International Agricultural Research (ACIAR) in which baseline surveys were conducted to understand farmers' practices of crop management based on the resources available. A second ACIAR project, reported here, studied the effects of six integrated and balanced nutrient management interventions developed in consultation with the farmers; these were compared with the farmers' practice for their effects on crop productivity. Seven Mother trials (each with three replications) were conducted during 2005-06 and 2006-07 on farmers' fields of Geelakhedi village (Rajgarh district) and Mughaliahat village (Bhopal district) in Madhya Pradesh, India. The soils, all vertisols, at all sites were low in organic C,

available N, P, S and Zn, but high in available K. Soybean (cv. JS 335) was grown in the monsoon (wet, summer) season, and wheat (cv. Lok-1) was grown in the rabi (dry, winter) season.

Later in 2007-08, 100 Baby trials were conducted in 10 surrounding villages of Rajgarh, Vidisha and Raisen districts to demonstrate and further validate the INM technology. In these trials, two successful nutrient management interventions viz., balanced fertilization (BF) through inorganic fertilizers alone (100% of the recommended NPKSZn fertilizer rate to soybean and 100% NPKS to wheat) and INM (50% NPKS+5 t FYM/ ha+*Rhizobium* to soybean and 75% NPKS+P-solubilizing bacteria (PSB) to wheat) were compared with the farmers' practice. Soil analyses indicated that the initial soil fertility status of 95 successful trial sites showed that all soils were low in available N. About 48% of soils were low in available P and 41% were low in available S. Available Zn was low in 52% of the soils, whereas 47% of soils were low in organic C. Overall, 32% of soils in the field sites were deficient in four nutrients viz. N, P, S and Zn.

Results

Mother trials

In the monsoon seasons, use of 50%NPKS+5t FYM/ha+*Rhizobium* increased the soybean grain yield by 13% over the 100%NPKSZn and by 28% over the farmers' practice, and saved synthetic fertilizer inputs of up to 42 kg N, 20 kg P, 13 kg K, 15 kg S and 5 kg Zn/ha during a soybean-wheat rotation. *Rhizobium* inoculation with 50%NPKS+5t FYM/ha produced 7% higher yield over 50%NPK+5t FYM/ha. In the rabi seasons, BF and INM produced significantly higher wheat grain yields over the farmers' practice. When crops are considered together as a soybean-wheat system (Table 1), INM yielded the highest net returns (Rs. 61,000/ha) which was 24% higher than that of the farmers' practice (Rs. 49,000/ha). The benefit:cost ratio (B:C) of INM was an estimated 2.86:1.

Table 1. Mean soybean and wheat grain yields and the economics of integrated nutrient management (INM), balanced fertilization (BF) and farmers' practice in a soybean-wheat system on vertisols in Madhya Pradesh, India.

Treatment details	Grain yield (t/ha)		Gross income (Rs/ha)	Total cost (Rs/ha)	Net return (Rs/ha)	B : C Ratio
	Soybean	Wheat				
*100% NPKSZn to soybean; 100%NPKS to wheat (BF)	1.95	5.09	83700	22700	61000	2.69
50%NPKS+5t FYM/ha to soybean; 75%NPKS to wheat (INM1)	2.05	4.86	81800	21600	60300	2.79
50%NPKS+5t FYM/ha+ <i>Rhizobium</i> to soybean; 75%NPKS+PSB to wheat (INM2)	2.18	4.87	83500	21600	61800	2.86
**Farmers' Practice	1.73	4.17	69600	20400	49200	2.41
*100% NPKSZn	Soybean – 25 kg N, 26 kg P, 17 kg K, 20 kg S and 5 kg Zn/ha Wheat - 120 kg N, 26 kg P, 17 kg K and 20 kg S/ha					
**Farmers' Practice	Soybean – 12.5 kg N and 13 kg P/ha Wheat – 80 kg N and 22 kg P/ha					

Baby trials

In the monsoon season, the pooled data of soybean grain yield from 95 sites revealed that the yield from BF was 23% higher than that from the farmers' practice. Notably, INM (50% NPKS+5 t FYM/ ha+*Rhizobium* to soybean) produced about 46% higher soybean grain yield as compared to the farmers' practice. It was especially interesting that there was a wide variation in soybean grain yield over the 95 successful trials. It was concluded that this was due to differences among soils (e.g. soil depth, waterlogging) and in farmer's success in controlling weeds and insect pests. The soybean grain yield ranged from 0.63 t/ha to 2.75 t/ha in the farmers' practice, from 0.75 t/ha to 3.33 t/ha in BF, and 0.85 t/ha to 3.63 t/ha under INM (Figure 1.).

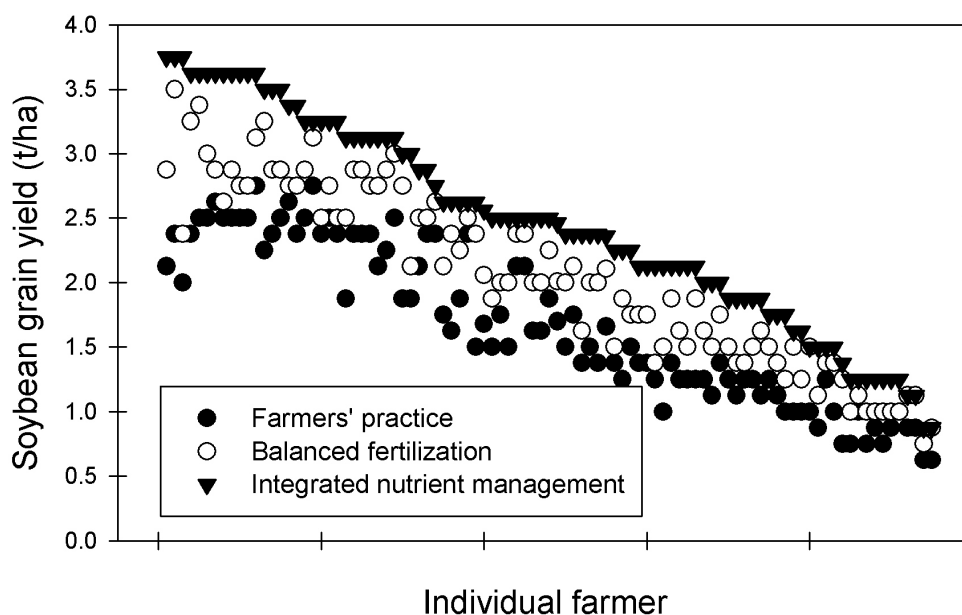


Figure 1. Soybean grain yield in Baby trials conducted by 95 farmers in their fields in Madhya Pradesh, India, testing the effects of integrated nutrient management, balanced fertilization and farmers' practice (see Table 1 for details).

Out of 95 Baby trials, the 60 best managed trials produced a mean soybean grain yield of 1.84 t/ha with farmers practice, 2.23 t/ha with BF and 2.68 t/ha with INM. In these well-managed fields, INM produced higher soybean yield by 46% over the farmers' practice and by 20% over BF. These results demonstrated that weed and pest management are important to get the full benefit from efficient nutrient management. About 12 farmers ended up with just 0.63-1.50 t/ha soybean yield even with BF and INM, possibly due to poor soils or poor management.

In the rabi season, the wheat crop was grown in the same plots with required amounts of nutrients in the farmers' practice, BF and INM. Four Baby trials out of 95 could not be harvested due to scarcity of irrigation water. Out of 91 successful trials, 45 farmers provided 3-4 irrigations, 12 farmers irrigated wheat twice and remaining 34 farmers could irrigate only once. The wheat which received 3-4 irrigations responded well to BF as well as INM (Figure 2). In these trials wheat grain yield was 3.38-4.38 t/ha with the farmers' practice, from 4.75-6.25 t/ha with BF and from 4.50-6.25 t/ha with INM. BF produced a higher wheat grain yield by 40% over the farmers' practice and by 6% over the INM.

It is noteworthy that Madhya Pradesh received only 70% of the normal rainfall during the monsoon of 2007. Thus, the wheat crop on 12 sites received only 2 irrigations. In these trials, BF produced higher grain yield by 21% and INM by 17% over the farmers' practice. The low monsoon rainfall resulted in 34 instances where the wheat crop was irrigated only once. These wheat crops did not respond to the BF or INM, with very low productivity as compared to that of wheat crops which received 3-4 irrigations.

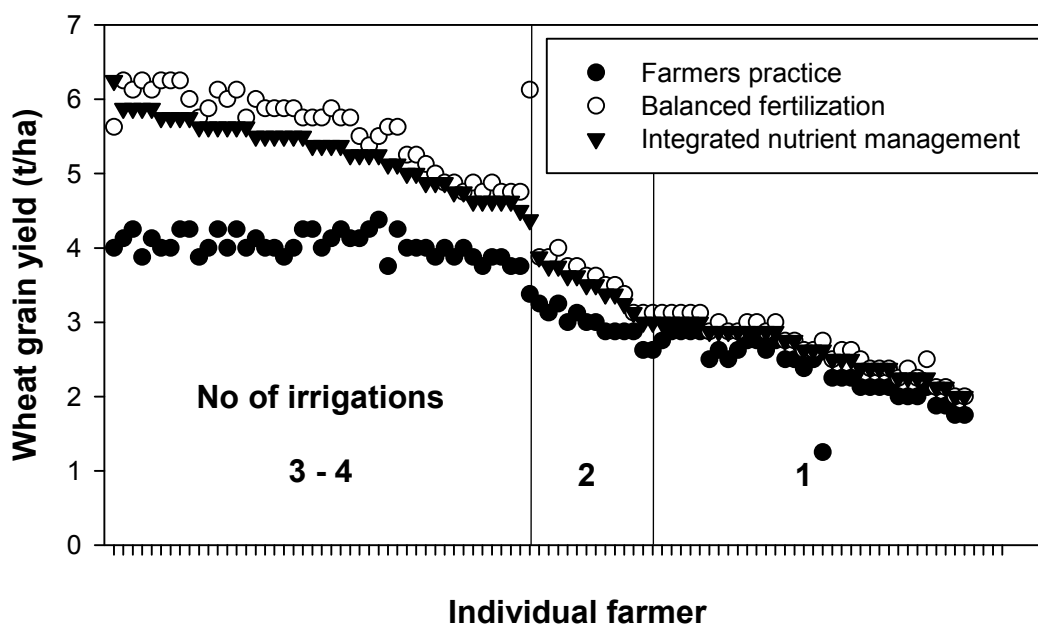


Figure 2. Wheat grain yield in Baby trials conducted by 91 farmers in their fields in Madhya Pradesh, India, testing the effects of integrated nutrient management, balanced fertilization and farmers' practice (see Table 1 for details).

Conclusions

In the Mother trials, both INM and BF markedly increased soybean and wheat grain yields over the farmers' practice. In the Baby trials conducted by farmers themselves, BF increased soybean grain yield by 23% and wheat grain yield by 30% over the farmers' practice. The choice of the either INM or BF by farmers depends upon the availability of farmyard manure, a resource that is not sufficient to cover the entire land holding of the medium and large farmers every year (Reddy *et al.* 2005). The MBT approach clearly demonstrated to farmers the magnitude that INM and BF technologies enhance the productivity of the soybean – wheat system in their own fields. Also, there was clear evidence that greater benefits arose only on good soils and with proper weed and pest management in soybean, and sufficient irrigation in wheat. Further success in adoption of INM and BF practices is envisaged given the enthusiasm of farmers and village organizations.

References

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