Optimalising Potato Productivity in Sembalun Highlands, Nusa Tenggara Barat – Indonesia

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Abstract

Potato cultivation in Nusa Tenggara Barat (NTB) Province of Indonesia locates in the Rinjani Valley highlands at 1,050 – 1,250 m above sea level. Farmers grow the Atlantic variety for a crisp processing company. The yield of Atlantic is low which is about 18.2 ton/ha, however, this is a profitable crop for farmers. Elsewhere in Indonesia the frequent cropping of potatoes has led to soil quality decline. To reduce the decline, potato farmers in NTB used compost and superphosphate to increase potato productivity. They also applied a new management technique. This is important because potatoes are a new crop in NTB and specific management suited to local conditions which has not yet been developed. The research was conducted at six farmers' fields and involving six Farmer Field School (FFS) groups. The compost treatments applied were local compost at 3,000 and 5,000 kg/ha. The super phosphate treatments applied were 300 and 600 kg/ha. Each treatment had six replicates by having six different farmer groups which had the same experimental design in their fields. The results showed that there was no significant difference in yields of super phosphate at 300 and 600 kg/ha which were 33.0 and 33.1 t/ha, respectively. Similarly there was not a significant difference in yield between the compost treatments with 3,000 kg/ha producing 33.0 t/ha, meanwhile with 5,000 kg/ha of compost produced 32.7 t/ha.

Keywords: productivity, potato, compost, farmer initiated learning, Nusa Tenggara Barat

Introduction

Potato (*Solanum tuberosum*) is an important vegetable commodity in Indonesia having a good market, both as a vegetable and raw material for food processing industries. Because of the high demands, potatoes are expected in the future for diversification of carbohydrate sources that may increase sustainability and overcome poverity in Indonesia. In Indonesia, potatoes are produced in 21 provinces, the biggest are in Sumatra and Java with the cropping area are around 64,148 ha. Demand for table and processing potatoes increases every year. The value of imported processing potatoes to Indonesia in 2007 was US$ 40 million whch was about 43,477 tonnes. In 2008 (from January to September) processing potato imports reached 29,187 tonnes with value of US$ 28 million. In 2009 Indonesia imported 48,000 tonnes with value of US$ 33 million. Indonesian domestic potato production has increased steadily at over 3% per annum since 1997 and reached 1,176,304 tonnes in 2009 (Badan Pusat Statistik, 2011).

Potato production is generally conventional and traditional or continuing from previous generations, so that yields are still low which is from 14.9 to16.4 tonnes/ha (average yield in Indonesia). Many problems are found to increase potato production in Indonesia including: (1) low quality and quantity of seed potatoes, which forms the main concern in the effort to increase potato production in Indonesia (Fuglie *et al.* 2006), (2) current conventional cultivation techniques (Kuntjoro, 2000), (3) topographic factors, where high areas with suitable temperatures for growing potatoes are very limited (Kuntjoro, 2000), (4) the tropical conditions are optimum for the development of pests and disease of potato crops (Kuntjoro, 2000).

In NTB, potatoes are mainly cultivated in the Sembalun sub-district on the slopes of Mount Rinjani, from about 1,050 to 1,250 m asl. Potatoes are now the most important horticultural commodity for the Sembalun community. The potato variety grown by Sembalun farmers is Atlantic with a yield of 18.2 tonnes/ha (BPTP NTB, 2009) which is still relatively low because in several potato studies in Indonesia the yield has been 35 tonnes/ha (BPTP NTB, 2009). Sembalun farmers can grow potatoes in the dry season as well as the wet season. In the wet season potatoes are planted in dryland that has a potential area of more than 1,500 ha and in the dry season potatoes are planted in paddy fields after the rice harvest in the months of June and July with a potential area of 1,105 ha. In 2010, the percentage of the paddy area used to produced potatoes was just 15 %.

The main constraint to development of Atlantic potatoes in Sembalun is sub-optimal application of integrated crop management (ICM). Farmers still predominantly use chemical fertiliser and do not use organic fertiliser although there is the potential to produce and develop the local organic fertiliser. Farmers are also accustomed to control pests and diseases with chemical pesticides without observing threshold levels indicating whether control is required or not, also apply mixtures of various pesticides together without paying attention to the active ingredients causing an impact on the important natural predators. The dominant use of chemical fertiliser and pesticides is the reason why potato enterprises have high costs. In fact the constant use of chemical fertiliser will damage the soil structure and make the soil hard (Nurmayulis and Maryati, 2008). Furthermore, the excessive use of chemical pesticides will destroy the insect biodiversity and lead to the death of insects and other microorganisms antagonistic to pests and pathogens (Nurmayulis and Maryati, 2008).

The constant practising of conventional potato production systems will reduce the profitability of farmers (BPTP NTB, 2009), and in the long term will cause environmental damage and the loss of biodiversity in this region (BPTP NTB, 2009). Because of this, a sustainable and environmentally friendly plan to support agricultural development through the study of optimalising potato yield in the Sembalun highlands is needed. Sembalun is a small, isolated potato production area without specialist potato support services and so research into optimising potato production inputs will have to be carried out by the farmers themselves with local extension workers.

To overcome the contraint of sub-optimal crop management a technique was required that enabled farmers to become their own researchers. The technique used was a modification to the FFS methodology. The aim was to instigate demonstration plots that allowed the impact of single management changes to be measured by farmers. Previously the potato FFSs had compared an ICM plot versus a conventional plot. This resulted in a range of management changes between the plots which made it difficult to identify the cause of improvements in profits between the treatments. We call this improved methodology Farmer Initiated Learning (FIL).

This research aimed to help farmers develop and put into use a less costly potato production system that will significantly increase the ability of small farmers to take up potato production in the Sembalun highland.

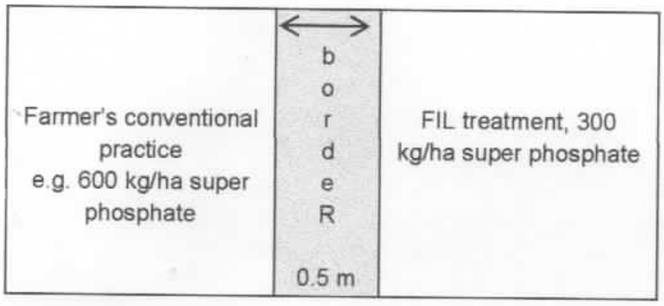
Materials and Methods

Experimental set-up

Simple FIL experiments to test one variable were introduced to Sembalun Farmer Field Schools in 2009. The research was conducted at six farmers' fields involving six Farmer Initiated Learning groups. At Sembalun six farmer groups compared the use of superphosphate with compost. The plots were around 1000 m^2 and all had a 50 m^2 yield assessment sub-plot pegged in the center. This meant that the yield measured by each farmer group came from the same size plot. The results from each farmer group were used as replicates. Results were presented on a t/ha basis. The experiment was located at the Sembalun highland of NTB. The FIL groups were all members of the overarching farmer group Kelompok Horsela. The experiment was conducted at one growing season from June to November 2009.

Cultural practices and conditions

The compost treatments applied were local compost at 3,000 and 5,000 kg/ha. The superphosphate treatments applied were 300 kg/ha and 600 kg/ha. Other fertilisers applied were the same and included; NPK 600 kg/ha and sulphate of ammonia 300 kg/ha. The plot design is shown in Figure 1.



To the left the farmers' usual rate of superphosphate was applied. To the right a lower experimental rate of superphosphate was applied. Plots varied in size according to individual. Yield was determined by harvesting a 50 m^2 sub-plot in the centre of each treatment.

Figure 1. Example of experimental plot design.

Statistical analysis

The simple experiments were executed to plan by the six farmer groups. Yields were measured and recorded from the yield sub-plots. The results from each of the six farmer groups were used as replicates in an ANOVA. All the data were statistically analysed using analysis of variance (ANOVA). The significance of treatment effect was determined using F-test, and to determine the significance of the difference between the means of the two treatments, least significant differences (LSD) were estimated at the 5% probability level.

Results and Discussion

There was no significant difference in yields from superphosphate applied at 300 and 600 kg/ha. The respective yields were 33.0 and 33.1 t/ha (Table 1). Similarly there wasn't a significant difference in yield between the compost treeatments with 3,000 kg/ha producing 33.0 t/ha while 5,000 kg/ha produced 32.7 t/ha (Table 1). This indicated that farmers can improve their efficiency of phosphate and compost, therefore, it also meant to improve income through the reduction in the input costs.

Super phosphate cost was 2000 Rp/kg (BPTP NTB 2009) and the average farmer uses was 433 kg/ha. The finding that 300 kg of super phosphate is sufficient for potato production in the paddy areas of Sembalun means that they can save 133 kg of super phosphate or 266,000 Rp/ha which will improve farmers' income through reduced input costs.

Compost at 5,000 or 3,000 kg/ha did not significantly affect the yield of potatoes. Manure costs 497 Rp/kg (BPTP NTB 2009) and the average farmer uses 3,192 kg/ha. The finding that 3,000 kg of compost is sufficient for potato production in the paddy areas of Sembalun means that there can be a saving of 192 kg of compost or 95,425 Rp/ha for the average farmer which will also improve farmer income because of reduced input costs. Farmers who use above average organic manure, the savings will be greater. For example, farmer who previously used 5,000 kg/ha of compost then he reduced to 3,000 kg/ha, the savings would be 994,000 Rp/ha.

Table 1. Results of Farmer Initiated learning-by-doing plots investigating the effect of lower super phosphate and compost rates – NTB 2009

Treatment	Description	Yield (t/ha)
Super phosphate		
300 kg/ha	experimental rate	33.0
600 kg/ha	farmers' usual application rate	33.1
Significance		ns
LSD		1.4
n		6.0
Compost		
3,000 kg/ha	experimental rate	33.0
5,000 kg/ha	farmer's usual application rate	32.7
Significance		ns
LSD		2.8
n		6.0

Conclusions

There was no significant difference in yields resulted from superphosphate at 300 and 600 kg/ha which produced 33.0 and 33.1 t/ha respectively. Similarly there wasn't a significant difference in yield between the compost treatments at 3,000 kg/ha producing 33.0 t/ha while at 5,000 kg/ha produced 32.7 t/ha. Therefore farmers can improve their efficiency of phosphate and compost inputs to improve income through reduced input costs. The six FIL groups within Kelompok Horsela demonstrated that these farmers and their agricultural extension workers now have the capacity to plan and coordinate a series of simple though specialized potato experiments. Sub-group results could be analyzed as replicates in an ANOVA of the combined results. This means that this isolated group of farmers can now undertake their own objective testing of new management techniques.

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