Vol. 18 · October 2014
Print ISSN 2012-3981 • Online ISSN 2244-0445
doi: http://dx.doi.org/10.7719/jpair.v18i1.290
Journal Impact: H Index = 3 from Publish or Perish

JPAIR Multidisciplinary Research is produced
by PAIR, an ISO 9001:2008 QMS certified
by AJA Registrars, Inc.

On-Farm Verification of Peanut Varieties in Rainfed and Lahar Laden Areas of Pampanga, Philippines

MARY GRACE B. GATAN
http://orcid.org/0000-0002-6083-0060
mbgatan.mgbg@gmail.com
Pampanga Agricultural College
Magalang, Pampanga

VIRGILIO DM. GONZALES
http://orcid.org/0000-0002-7476-4703
virgon3000@gmail.com
Pampanga Agricultural College
Magalang, Pampanga

ABSTRACT

Lahar sediment areas represent drought-prone growing ecosystems due to their sandy texture and low organic matter. Peanut, a rainfed crop has been a common option in such areas, where yields are usually less than 1.0 t ha^{-1}. Hence, on-farm trials were conducted in farmers' field to introduce and evaluate the drought-resistant varieties in relation to yield performance, reaction to diseases, profitability, farmers' acceptability and market preference. Introduced varieties were the pink-seeded NSIC Pn11 and red-seeded ICGV 99046 which were compared with red-seeded farmers' variety in wet and dry seasons. Varieties were arranged in randomized complete block design of four replicate farms. Pod yield of introduced varieties ranged from 2.4 to 3.0 tons/ha, higher than the yield obtained in farmers' variety (1.7-1.9 tons/ha) in both seasons. ICGV

99046 recorded the highest yield across two cropping seasons (2.9-3.0 tons/ha). High yield of introduced varieties was associated with greater pod number per plant, higher 100-seed weight, higher shelling percentage, longer number of days to maturity, and resistance to fungal diseases. Net farm income from adopting introduced peanut varieties was 123-230% higher than that obtained using farmers' variety. The growing of conventional farmers' variety resulted to low benefit cost ratio of less than 1.0 while the use of introduced varieties generated a benefit cost ratio of more than 1.0. Red-seeded varieties are predominantly preferred by farmers and market entities. The study demonstrated the advantage of adopting red-seeded ICGV 99046 for improving peanut yield, increasing farm income, and acceptability by farmers and market entities.

Keywords **-** Agriculture, on-farm trial, *Arachis hypogaea*, lahar, rainfed, Pampanga, Philippines

INTRODUCTION

At least 80% of the global agricultural land area is rainfed. It is well established that drought causes substantial reduction in the economic yield of crops. Water limitation is a major threat to food security, sustainability of production systems, and adversely affects the socio-economic status of 2.6 billion people living in drought-prone areas. People in drought-prone areas represent 43% of the world population, which are engaged in agriculture (Saxena & O'Toole, 2002). In 2008, Africa has only 5% of cultivated lands supported with irrigation, 11% in the Americas, and 7% in Europe (UNESCO, n.d.). About 22% of crop lands in Southeast Asia is irrigated. In 2006, about 19% of crop lands in the Philippines is irrigated. Due to increasing population, availability of water is a potential threat to agriculture in the future.

Meanwhile, the lahar sediment areas in Central Luzon, Philippines are typically drought-prone due to Mt Pinatubo eruption in 1991. Provinces affected by lahar sediments include Pampanga, Tarlac and Zambales. Most lahar sediments contain at least 87% sand (Reyes & Neue, 1991) which have been recognized to pose several production constraints in agriculture. The low moisture holding capacity or high infiltration rate makes coarse-textured lahar sediment not economically feasible for irrigation. Previous researches have suggested that it would take several decades to restore the fertility of lahar-deposit areas, unless farmers resort to soil amelioration and revegetation with gramineous and leguminous plants (BSWM, 2010). In these areas, peanut (*Arachis hypogea* L.) has been a typical rainfed crop where farmers' yield is about one ton per hectare or lower.

Peanut yields are generally low and unstable under rainfed conditions, due to unreliable rainfall patterns, with frequent droughts, and to a limited availability and adoption of high-yielding varieties. In rainfed areas, farmers are predominantly resource poor, with small farm size and a limited financial capacity to adopt high-input technologies (Saxena & O'Toole, 2002). Peanut is a major rainfed crop in most of the production systems in south Asia and sub-Saharan Africa (Serraj et al., 2003).

To minimize the effects of drought on crops, drought-tolerant varieties are appropriate farmer-friendly, seed based technology that is simpler and easier to introduce than production technologies that require additional input. However, several factors are involved for farmers' choice and adoption of any introduced peanut variety. Farmers may either adopt or reject any introduced variety depending on its yield advantage over the conventional farmers' variety, market preference (Omot, 2006), farmers' weed control practices, length of the growing season (Craufurd et al., 2000), agro-ecosystem and soil type (Santos, 2012). In previous trials conducted in drought-prone peanut growing areas, the pink-seeded NSIC Pn 11 outyielded the farmer's variety only in farms free of significant weed population. However, red-seeded varieties are preferred by farmers in Pampanga due to higher market demand relative to introduced pink-seeded varieties. In Papua New Guinea, majority of middlemen and consumers preferred large white kernels, while most growers had no preference regarding seed size and color (Omot, 2006). Peanut varieties whose growth cycle is longer than the duration of growing season in a specific location either fail to mature or mature at a time the soil is too hard to dig the pods (Craufurd et al., 2000). ICGV 99046 was recommended in areas with continuous irrigation and clay loam soil type. On the other hand, NSIC Pn14 was found suitable in rainfed areas with sandy loam soil while the red seeded farmer's variety performed well in rainfed areas with clay loam soil type (Santos, 2012).

Many peanut varieties have been released and introduced in the Philippines, and it is important for farmers to evaluate them on their farm to determine if adopting a new variety would be beneficial (Tillman et al., 2012). However, peanut varieties differ in their agro-climatic adaptation. Agronomic and yield performance of genotypes may vary from location to location. Aside from yield advantage, however, farmers' acceptance of introduced varieties is dependent on market preferences. There is, therefore, a need to ascertain farmers' preferences on peanut varieties in specific location based on soil type, climatic conditions, cultural practices and market demand.

OBJECTIVE OF THE STUDY

This study was conducted to verify and establish the yield performance, and acceptability of both farmers on promising lines/varieties of peanut in drought-prone lahar-sediment farms under rainfed environment.

MATERIALS AND METHODS

Selection and Identification of Farmer-Cooperators

Selection and identification of farmer-cooperators were based on the following criteria: willingness to allocate an area for the trial; willingness to adopt technologies that will be introduced; capability and willingness to extend and share information to other farmers; and accessibility of the farm. Identified farmer-cooperators were oriented on the project methodology with emphasis on peanut production prior to the establishment of varietal trials.

Varieties evaluated

Agronomic description of peanut varieties evaluated is presented on the table below:

Variety	Agronomic Characteristics			
	Seed size	Seed color	Seed number per pod	Maturity (days)
Traditional farmers' variety	small	red	3	80-90
ICGV 99046	medium to large	red	2	110-120
NSIC Pn11	medium to large	pink	2	105-115

Establishment of on-farm trials

One farmer-managed trial was established per municipality. Trials were implemented in four peanut growing municipalities namely, Magalang, Apalit, Mabalacat and Arayat in Pampanga, Philippines during the wet season (June-October) and dry season (October-January). Seeds of introduced varieties, and other production inputs such as fertilizers, inoculants, pesticides were provided to the farmer cooperators. For a given farm, an area measuring about 100-200m^2 were allotted for each variety. Varieties were arranged in randomized complete block (RCB) design with four replications. One pilot farm per municipality served as one replication or block.

Data collection

Reaction to diseases. Varietal reaction to major foliar diseases, *Cercospora* leaf spot and rust were recorded at harvest using the rating scale below:

Scale	Description
1	No infection
2	1-5% infection
3	6-25% infection
4	26-50% infection
5	More than 50% infection

Disease rating scale of each variety was converted into corresponding disease reaction by obtaining the average scale per entry for all replications. The final disease rating was determined based on the following:

Range of Average Scale	Final Disease Reaction
1	Immune
2	Resistant
3	Moderately resistant
4	Moderately Susceptible
5	Highly susceptible

Agronomic Characteristics. The number of days to maturity was recorded from the emergence to the date when at least 75% of the pods had dark brown color with deep ridges. Stem length was measured using a meter stick from the randomly selected sample plants. Number of seeds per pod was based on 10 randomly selected matured pods from the 10 sample plants. Number of pods per plant was the average number of pods per plant at harvest from same 10 random sampled plants used for stem length determination. The 100-seed weight was based on randomly selected 100 seeds from each plot. Shelling percentage was computed as the percentage weight of shelled pods from 100-gram pod sample. Pod weight per unit area was obtained as the dry weight after drying for three to four days 3-4 days of sun drying. After which, dry weight of harvested mature pods from the area was weighed.

Agronomic data were analyzed using Analysis of Variance (ANOVA). Treatment means were compared using Least Significant Difference (LSD) test.

Survey on Farmers and Market Preferences

Pre-tested questionnaire was used to determine preferences of peanut growers and market entities in the top five peanut growing municipalities in Pampanga, which include Bacolor, Arayat, Porac, Apalit and Angeles City. The respondents were peanut growers, peanut vendors and processors. The questionnaires were distributed and retrieved from the respondents. An actual interview to the respondents was conducted to validate their response and clarify points that were deemed inadequate. To comply with research ethics protocol, the researchers obtained informed consent from everyone who was interviewed on given questions to answer.

Data were collated, tabulated, and analyzed after which were categorized according to their solved percentage. A simple tabular analysis was made consisting of a percentage on the collected data.

RESULTS AND DISCUSSION

On-Farm Trials

Agronomic characteristics, yield components and pod of different varieties both for wet and dry seasons are reflected in Tables 1 and 2.

During wet season planting, significant differences were noted among peanut varieties in terms of pod yield, yield components and stem length (Table 1). NSIC Pn11 apparently exhibited the longest stem length among varieties. Long stem length has an advantage in weed competition. Both NSIC Pn 11 and ICGV 99046 consistently obtained higher number of pods per plant, weight of 100 seeds and pod yield when compared to the farmers' variety. The farmers' variety recorded greater seed number per pod than the introduced varieties. However, NSIC Pn 11 and ICGV 99046 exhibited larger grain size than the farmers' variety as indicated by their high 100-seed weight. Shelling percentage was highest in the red-seeded ICGV 99046 among the varieties evaluated. The introduced varieties out yielded farmers' variety. Varietal differences in pod yield reflected variation in pod number per plant, shelling percentage and 100-seed weight.

Peanut plants grown during the dry season had shorter stem length relative to those grow during the wet season (Table 2). There were no varietal differences in stem length, pod number per plant, and shelling percentage during the dry season. However, ICGV 99046 recorded the highest pod yield among the varieties. Varietal differences in pod yield were associated with genotype variation in 100-seed weight. Consistent with wet season trials, introduced peanut varieties recorded higher yields than the conventional farmers' variety.

Table 1. Agronomic characteristics and yield of peanut varieties in lahar sediment farms during wet season.

Parameter	Variety⁺		
	Farmers variety	NSIC Pn 11	ICGV 99046
Days to maturity	91.5	104.5	105.0
Stem length at harvest (cm)	44.89 c	96.35 a	54.96 b
Pod number per plant	7.00 b	16.92a	19.25 a
Seed number per pod	2.3 a	2.0 b	1.7 c
Weight of 100 seeds (g)	28.0 b	54.0 a	55.0 a
Shelling percentage (%)	60.0 c	70.0 b	77.0 a
Pod yield (tons/ha)	1.67 b	2.63 a	3.0 a

⁺Means within the same row followed by a common letter are not significantly different at 5% LSD level

Table 2. Agronomic characteristics and yield potential of peanut varieties grown in lahar sediment farms planted during dry season

Parameter	Variety⁺		
	Farmers' variety	**NSIC Pn 11**	**ICGV 99046**
Days to maturity	95.0	112.0	114.0
Stem length at harvest (cm)	43.95	45.70	44.40
Pod number per plant	17.4	21.8	21.1
Seed number per pod	2.5 a	2.0 b	2.0 b
Weight of 100 seeds (g)	38.3 c	51.0 b	66.0 a
Shelling percentage (%)	67.0	71.0	71.0
Pod yield (tons/ha)	1.9 c	2.4 b	2.9 a

⁺ Means within the same row followed by a common letter are not significantly different at 5% LSD level

The yields recorded (1.7-3.0 t ha^{-1}) were comparable with those reported in Papua New Guinea for 90-120 day varieties, 1.1-3.2 t ha^{-1} (Saese et al., 2006). However, the recorded yields were higher than those recorded in India, 1.3-1.7 t ha^{-1} (Nigam et al. 2005) in Tanzania, 0.6-1.2 t ha^{-1} (Bucheyeki et al., 2008). There were reported on-farm trials indicating that introduced peanut varieties did not exhibit yield advantage over the farmers' varieties (e.g. Saese et al. 2006). In one of the two farmer participatory trials, introduced peanut varieties produced pod yields not significantly different from the farmers' variety (Nigam et al. 2005). However, the farmers were impressed with the introduced variety which gave higher fodder yield with more green leaves, and comparable pod yield and larger seed size than the farmers' variety despite severe drought conditions in the cropping season (Nigam et al. 2005).

The advantage of new improved peanut varieties over conventional farmers' varieties in farmer-participatory trials, however, has been established in drought-prone peanut growing areas (Bucheyeki, 2008; Nigam et al., 2005; Kuniata, 2006; Adu-Dapaah et al., 2007, Dela Cruz, 2011). In Andhra Pradesh, India, for example, ICGV 91114 produced significantly higher average pod yield and greater haulm yield by 12% and 25%, respectively over the farmers' variety, TMV 2 (Nigam et al, 2005). In Tanzania, Pendo (1444 kg ha^{-1}) and Johari (1163 kg ha^{-1}) outyielded Mamboleo (547 kg ha^{-1}), a farmers' variety (Bucheyeki, 2008). Farmer-participated trials in Ghana, Africa demonstrated the apparent yield advantage of introduced varieties over the common farmers' variety (Adu-Dapaah et al., 2007). As with the farming situation in Pampanga, the farmers' variety matured earlier than the improved varieties. Early maturing farmers' variety in Ghana yielded about a ton per hectare while the introduced varieties recorded yield of more than 2.0 tons ha^{-1}. The advantage of introduced new varieties was attributed to higher shelling percentage and greater number of pods per plant, high fodder yield and resistance to foliar diseases over the farmers' variety. In the present trial, the yield advantage of introduced varieties relative to farmers' variety during wet season was associated with high pod number per plant, greater 100-seed weight and high shelling percentage. During the dry season, differences in pod yield were mainly due to variation in 100-seed weight.

Two foliar diseases were observed namely, Cercospora leaf spot (CLS) and peanut rust in both wet (Table 3) and dry season trials (Table 4). The ICGV 99046 and NSIC Pn11 were noted to be resistant against CLS and rust at any cropping season while farmers' variety was recorded susceptible to both CLS and peanut rust. Leaf spot and rust diseases are major foliar diseases of peanut. Variation in foliar disease reaction among genotypes has been reported elsewhere between short duration and medium duration varieties (Saese et al. 2006). Medium duration varieties have been shown being consistently resistant to both leaf rust and late leaf spot than short duration varieties. The present study was consistent with the findings of Saese et al. (2006) which indicated the susceptibility of the farmers' variety (92-95 days) when compared to introduced late maturing varieties (105-114 days).

Meanwhile, the short-duration varieties developed at ICRISAT have shown 23–411% superior pod yield over local control varieties in the seventh series of international trials across several countries (Serraj et al., 2003). While early maturity is a drought escape strategy (i.e. harvesting the crop before the occurrence of detrimental dry spell), early-maturing genotypes usually have shallow root systems aside from their susceptibility to foliar diseases (Saese et al. 2006). This makes them more susceptible to intermittent drought grown as a rainy-season crop and with consequent reduction of the yield potential. Nevertheless, genotypic differences in rooting depth have been observed in peanut suggesting scope for combining early maturity with an efficient root system (Serraj et al., 2003).

Table 3. Reaction to diseases of peanut varieties during wet season

Foliar Disease	Farmer's Variety	NSIC Pn 11	ICGV 99046
		Disease rating scale+	
Cercospora leaf spot	4.10 b	1.90 a	1.70 a
Rust	3.30 b	2.00 a	2.07 a

+ Means within the same row followed by a common letter are not significantly different at 5% LSD level.

Table 4. Reaction to diseases of peanut varieties under lahar sediment areas during dry season.

Foliar Disease	Farmer's Variety	NSIC Pn 11	ICGV 99046
		Disease rating scale+	
Cercospora leaf spot	4.2 b	2.3 a	2.0 a
Rust	3.4 b	2.0 a	2.1 a

+ Means within the same row followed by a common letter are not significantly different at 5% LSD level

Preferences of Farmers and Market Entities

Based on surveys, most of the farmers prefer red-seeded variety with small to medium seed size consisting of 2-3 seeds per pod (Table 5). In addition, they prefer early maturing variety but were willing to use both traditional farmers' variety and introduced varieties. Farmers usually grow peanut from March-June, August and November. However, majority prefer May as the planting month which is the onset of rainy season in Pampanga.

Red-seeded varieties were a common choice due to higher demand in the local market relative to pink seeded varieties. Only one out four peanut growers in Pampanga preferred the large-seeded varieties. In Papua New Guinea, however, majority of middlemen and consumers preferred large white kernels, while most growers had no preference one way or the other regarding size and colour (Omot, 2006). Middlemen ranked size and color the same as consumers, indicating that they are aware of consumer preferences. In Pampanga, the common farmers' variety is an early maturing variety with small, red-colored seeds. During the last decades, most improved varieties introduced are late maturing with large pink seeds. Nevertheless, farmers interviewed are divided in relation to choices between traditional and introduced varieties. The red-seeded ICGV 99046 should satisfy the preference of both the farmers and market entities.

Greater proportions of farmers prefer peanut planting at the onset of wet season (May) in Pampanga, although planting months have spanned from March to November. This indicates that soil moisture at planting is a dominant factor in planting decisions. In Papua New Guinea, peanut growers indicated that peanuts planted outside the optimal time produced lower yields. However, some farmers cultivate peanut during the off-season to take advantage of better market demand and prices (Wemin et al., 2006). In Pampanga, November plantings could have been due to peanut option as a second crop after wet season rice.

Cost and Returns

Tables 6-8 present the cost and return analysis of red seeded farmers' variety, NSIC Pn 11 and ICGV 99046 per ha. Yield of farmers' variety is up to 1.7 tons/ha with a total net income of Php 28,236.80 (USD 630.29) and a return on investment of 49.7%. On the other hand, the potential yield of NSIC Pn 11 is 2.7tons/ha while the net income could reach up to Php 69,326.00 (USD 1,547.46) and 49.7 ROI. With regards to ICGV 99046, 154% return on investment is expected from the 3 tons/ha production yield with a net income of Php 93,326.00 (USD 2,083.17).

Table 5. Preference of farmers and market on the agronomic characteristics of peanut in Pampanga, Philippines

1. Seed color	Red			Pink		
	87.5%			12.5%		
2. Seed size	Small	Medium		Large		
	37.5%	37.5%		25%		
3. No. of seeds/ pod	1	2	3		4	
	-	37.5%	50%		12.5%	
4. Maturity (No. of days from planting up to harvest)	90	100	110		120	
	50%	25%	25%		-	
5. Variety	Traditional			Introduced		
	50%			50%		
6. Month of planting	March	April	May	June	Aug	Nov
	6.25%	6.25%	37.5%	25%	12.5%	12.5%

Since farmers' variety is early maturing and can be harvested in three months time, the expected income per month is about Php 9,412.27 (USD 210.10). Both NSIC Pn 11 and ICGV 99046 are late maturing varieties and were harvested four months after planting were expected to generate a monthly net income of Php 17,331.50 (USD 386.86) and Php 23,331.50 (USD 520.790), respectively. Net farm income from adopting introduced peanut varieties was 123-230% higher than that obtained using farmers' variety. The use of the conventional farmers' variety recorded low benefit cost ratio (BCR) of less than 1.0, i.e. USD 0.50 return is expected to be generated for every USD1.00 invested. Should the introduced varieties will be grown, BCR computed was greater than 1.0, with ICGV 99046 and NSIC Pn 11 generating a BCR of 1.14 and 1.54, respectively.

The higher production cost recorded for the introduced varieties relative to that of farmers' variety was due to higher seed cost when procuring seeds of introduced varieties (Tables 7 and 8 vs. Table 6). Labor and material cost of peanut production in the present study ranged from USD856-910 per hectare which were fairly similar with the cost in Bulgaria, USD 947 (Bencheva et al. 2008) but higher than that reported in Papua New Guinea, USD451 (Wemin et. al 2006) and in Nigeria, USD125 (Adinya, 2009). Net returns ranged from

USD 1, 267-2,083, higher than that reported in Bulgaria, USD 172 (Bencheva et al. 2008) and in Nigeria, USD 7.58 (Adinya, 2009).

The trials in the present study demonstrated the advantage of adopting improved varieties particularly the red-seeded ICGV 99046 in increasing yield and income of peanut farmers. Adoption of improved peanut varieties, however, may be hindered by limited access of farmers to high yielding varieties, and inappropriate agronomic practices (Rachaputi, 2006). For example, previous dry season trials in Bacolor have shown that a drought-resistant variety yielded lower than the farmers' variety "Kalbo" in weedy farms (unpublished data). The introduced variety has shorter plant height and higher harvest index (pod yield/ total dry weight) than the weed taller farmers' variety with low harvest index. Therefore, in farmers' field where there were significant weeds, the farmers' variety recorded higher pod yields than introduced drought resistant variety due to its tall plant characteristics.

Table 6. Cost and return analysis on peanut production per hectare of red seeded farmers' variety during the wet season.

Item	Quantity	Unit	Rate/unit		Value	
			PhP	USD	PhP	USD
I. Gross Income						
Production/ Seed Yield (tons/ha)	1,700	kg	50	1.12	85,000	1897.32
II. Expenses						
Operating expenses						
1. Labor						
Land preparation(plowing, harrowing)	3, 400	contract			3,400	75.89
Furrowing	4	MAD	500	11.16	2,000	44.64
Inoculation/planting	10	MD	300	6.70	3,000	66.96
Hilling-up	10	MAD	300	6.70	3,000	66.96
Harvesting	25	MD	300	6.70	7,500	167.41
Stripping	10	MD	300	6.70	3,000	66.96
Irrigation	5	MD	300	6.70	1,500	33.48
Hauling and Drying	5	MD	300	6.70	1,500	33.48
Total Labor Cost					**24,900**	**555.80**

2. Material Inputs						
Seeds	120	kg	50	1.12	6,000	133.93
Fertilizer	4	bags	1,200	26.79	4,800	107.14
Inoculant (100g/50kg of seeds)	2	packs	80	1.79	160	3.57
Fuel		liters	500.00		2,500	55.80
Total Material Inputs					**13,460.0**	**300.45**
Land Charge*					**13, 800.0**	**308.03**
Interest on Capital**					**4,603.2**	**102.75**
TOTAL EXPENSES					**56,763.2**	**1267.04**
NET INCOME					**28,236.8**	**630.29**
RETURN OF INVESTMENT (%)					**49.70**	**49.70**
BENEFIT COST RATIO					0.50	0.50

Table 7. Cost and return analysis on peanut production per hectare of NSIC Pn 11 at wet season.

Item	**Quantity**	**Unit**	**Rate/unit**		**Value**	
I. Gross Income			**PhP**	**USD**	**PhP**	**USD**
Production/Seed Yield (tons/ha)	2,600	kg	50	1.12	130,000	2901.79
II. Expenses						
Operating expenses						
1. Labor						
Land preparation(plowing, harrowing)	3, 400	contract	1		3,400	75.89
Furrowing	4	MAD	500	11.16	2,000	44.64
Inoculation/planting	10	MD	300	6.70	3,000	66.96
Hilling-up	10	MAD	300	6.70	3,000	66.96
Harvesting	25	MD	300	6.70	7,500	167.41
Stripping	10	MD	300	6.70	3,000	66.96
Irrigation	5	MD	300	6.70	1,500	33.48

Hauling and Drying	5	MD	300	6.70	1,500	33.48
Total Labor Cost					**24,900**	**555.80**
2. Material Inputs						
Seeds	120	kg	70	`	8,400	187.50
Fertilizer	4	bags	1,200.00	26.79	4,800	107.14
Inoculant (100g/50kg of seeds)	2	packs	80	1.79	160	3.57
Fuel		liters	500	11.16	2,500	55.80
Total Material Inputs					**15,860**	**354.02**
Land Charge*					**13, 800**	**308.03**
Interest on Capital**					**6,114**	**136.47**
TOTAL EXPENSES					**60,674**	**1,354.33**
NET INCOME					**69,326**	**1,547.46**
RETURN OF INVESTMENT (%)					**114.30**	**114.30**
BENEFIT COST RATIO					**1.14**	**1.14**

Table 8. Cost and return analysis on peanut production per hectare of ICGV 99046 grown during the wet season

Item	**Quantity**	**Unit**	**Rate/unit**		**Value**	
I. Gross Income			**PhP**	**USD**	**PhP**	**USD**
Production/Seed Yield (tons/ha)	3,080	kg	50		154,000	3,437.51
II. Expenses						
Operating expenses						
1. Labor						
Land preparation(plowing, harrowing)	3, 400	contract			3,400	75.89
Furrowing	4	MAD	500	11.16	2,000	44.64
Inoculation/planting	10	MD	300	6.70	3,000	66.96
Hilling-up	10	MAD	300	6.70	3,000	66.96
Harvesting	25	MD	300	6.70	7,500	167.41

Stripping	10	MD	300	6.70	3,000	66.96
Irrigation	5	MD	300	6.70	1,500.	33.48
Hauling and Drying	5	MD	300	6.70	1,500	33.48
Total Labor Cost					**24,900**	**555.80**
2. Material Inputs						
Seeds	120	kg	70	1.56	8,400	187.50
Fertilizer	4	bags	1,200	26.79	4,800	107.14
Inoculant (100g/50kg of seeds)	2	packs	80	1.79	160	3.57
Fuel		liters	500	11.16	2,500	55.80
Total Material Inputs					**15,860**	**354.02**
Land Charge*					**13, 800**	**308.03**
Interest on Capital**					**6,114**	**136.47**
TOTAL EXPENSES					**60,674**	**1,354.33**
NET INCOME					**93,326**	**2083.17**
RETURN OF INVESTMENT (%)					**154**	**154**
BENEFIT COST RATIO					1.54	1.54

This study was delimited on the performance of peanut varieties grown in rainfed and lahar laden areas of Pampanga, Philippines simply to determine its yield potential, reaction to diseases, profitability, farmers' acceptability and market preference.

CONCLUSIONS

The new peanut varieties (NSIC Pn 11, ICGV 99046) out yielded the farmers' variety in both wet and dry season croppings in farmers' fields. Pod yield in both seasons was in the order ICGV 99046 > NSIC Pn 11 > farmers' variety. Yield advantage of introduced varieties relative to farmers' variety during wet season was associated with high pod number per plant, greater 100-seed weight and high shelling percentage. During the dry season, differences in pod yield were mainly due to variation in 100-seed weight. Both introduced varieties exhibited resistance to *Cercospora* leaf spot and rust while the farmers' variety was susceptible to such foliar diseases. The introduced varieties were late maturing relative the early maturing farmers' variety. Net farm income computed was one to two-folds higher in introduced peanut varieties compared with that of farmers' variety. The growing of conventional farmers' variety resulted to low benefit cost ratio of less than 1.0. Benefit cost ratio of more than 1.0 was recorded in introduced peanut varieties. Use of ICGV 99046 generated USD1.50 return for every USD1.00 invested.

Red-seeded varieties are predominantly preferred by farmers and market entities. Planting months varied among farmers interviewed which commenced from March to November. However, May was the most common month of planting for peanut. Five out of ten peanut growers preferred late maturing varieties (100-110 days). This study demonstrated the benefits of adopting the red-seeded ICGV 99046 for improving peanut yield, increasing farm income and acceptability by farmers and market entities.

ACKNOWLEDGMENT

The authors expressed their sincerest gratitude to the Department of Agriculture - Region III, Philippines for providing financial assistance to this project.

LITERATURE CITED

Adinya, I. B. (2009). Analysis of costs-returns profitability in groundnut marketing in Bekwarra local government area cross river State, Nigeria. *The Journal of Animal & Plant Sciences*, *19*(4), 212-216.

Adu-Dapaah, H. K., Asumadu, H., Lamptey, J. N. L., Haleegoah, J., & Asafo-Adjei, B. (2007). Farmer participation in groundnut varietal Selection. *African Crop Science Society*, *8*, 1435-1439.

Bencheva, N., Ligeon, C., Delikostadinov, S., Puppala, N., & Jolly, C. (2008). Economic and financial analysis of peanut production in Bulgaria. *Journal of Central European Agriculture*, *9*(2), 274-282.

Bucheyeki, T. L., Shenkalwa, E. M., Mapunda, T. X., & Matata, L. W. (2008). On-farm evaluation of promising groundnut varieties for adaptation and adoption in Tanzania. *African Journal of Agricultural Research*, *3*(8), 531-536.

Bureau of Soil and Water Management (BSWM). 2010. Geographic Extent of Mt. Pinatubo Volcanic-ash Influenced Soils Using Remote Sensing: A Time Series Study on Soil Formation and Development. Soilscape 1: 3-20 (Available at: http://www.bswm.da.gov.ph/ladaphilippines/newpdfs/2010%20First%20 Quarter%20Issue.pdf). Retrieved on Oct 26, 2014.

Craufurd, P. Q., Wheeler, T. R., Ellis, R. H., Summerfield, R. J., & Vara Prasad, P. V. (2000). Escape and tolerance to high temperature at flowering in groundnut (Arachis hypogaea L.). *The Journal of Agricultural Science*, *135*(04), 371-378.

Dela Cruz, R.T. 2011. Two promising peanut lines from ICRISAT recommended as NCT entries @ http://www.bar.gov.ph/barchronicle/2011/june2011_ news3.asp.

Department of Public Works and Highways – Mt. Pinatubo Emergency Project Management Office (DPWH-MPE-PMO) 1998. Final Report for Pinatubo Hazard Urgent Mitigation Project. II. Agricultural Development Planning for Sacobia-Bamban River Basin. Nippon Koei Co. Ltd. – PHILKOEI International, Inc. pp. 4-67.

Kuniata, L. S. (2006). Evaluation of peanut varieties suitable for the upper Markham Valley, Papua New Guinea. *Improving yield and economic viability of peanut production in Papua New Guinea and Australia*.

Nigam, S. N., Aruna, R., Giri, D. Y., Reddy, T. Y., Subramanyam, K., Reddy, B. R. R., & Kareem, K. A. (2005). Farmer participatory varietal selection in groundnut–A success story in Anantapur, Andhra Pradesh, India. *International Arachis Newsletter*, *25*, 13-15.

Omot, N., Wilson, T., Anzen, J., Ramakrishna, A., Tomda, Y., & Geob, T. (2006). Progress report on a peanut market study in Papua New Guinea. *Improving yield and economic viability of peanut production in Papua New Guinea and Australia*.

Rachaputi, R. C. (2006). Improving yield and economic viability of peanut production in Papua New Guinea and Australia using integrated management and modelling approaches—overview of ACIAR project ASEM 2001/055. *Improving yield and economic viability of peanut production in Papua New Guinea and Australia*.

Reyes, R. Y., & Neue, H. U. (1991). Characterization of the volcanic ejecta from Mount Pinatubo and its impact on rice production. *Philippine Journal of Crop Science*, *16*(2), 69-73.

Saese, H., Fahey, G., & Bafui, J. (2006). Evaluation of peanut (Arachis hypogaea L.) varieties in the lower Markham Valley of Papua New Guinea.*Improving yield and economic viability of peanut production in Papua New Guinea and Australia*.

Saxena, N. P., & O'Toole, J. C. (2002). *Field Screening for Drought Tolerance in Crop Plants with Emphasis on Rice Proceedings of an International Workshop on Field Screening for Drought Tolerance in Rice 11-14 Dec 2000*. International Crops Research Institute for the Semi-Arid Tropics.

Serraj, R., Bidinger, F. R., Chauhan, Y. S., Seetharama, N., Nigam, S. N., & Saxena, N. P. (2003). Management of drought in ICRISAT cereal and legume mandate crops. *Water Productivity in Agriculture: Limits and Opportunities for improvement, CABI Publishing, Wallingford, UK*, 127œ144.

Tillman, B. L., Gomillion, M. W., McKinney, J., Person, G., Thomas, W. D., & Smith, C. (2012). Methods for On-Farm Testing of Peanut Varieties in Florida with Results from 2005? 2009.

UNESCO (undated). Irrigated Land as Percentage of Cultivated Land, 2008. Retrieved on October 10, 2014 from http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/SC/temp/wwap_pdf/Irrigated_land_as_a_percentage_of_cultivated_land.pdf

Wemin, J. M., Ramakrishna, A., Geob, T., & Rachaputi, R. C. (2006). Production, processing, consumption and utilisation of peanut in Papua New Guinea—a survey of peanut growers. *Improving yield and economic viability of peanut production in Papua New Guinea and Australia*.