BIBLIOGRAPHY

GASIGAS, KIRBY D. APRIL 2012. Potato (*Solanum tuberosum* L.) Growth, Yield, and Tuber Dry Matter as Affected by Nitrogen and Potassium Fertilizer Levels. Benguet State University, La Trinidad, Benguet.

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ABSTRACT

The study was conducted at the Horticulture Experiment Field, Benguet State University, La Trinidad, Benguet from November 2011 to February 2012 to determine the effects of different rates of nitrogen and potassium fertilizer application on the growth, yield, and tuber dry matter content of potato and on the economics of growing the crop.

Results reveal that although vegetative growth and yield were not significantly affected by the fertilizers applied, marketable yield at 24.83 t/ha and return on investment at 62.78 % were greater with the application of 210-140-140 kg N-P_2O_5-K_2O/ha. Tuber dry matter content was significantly higher with the application of 140-140-210 kg N-P_2O_5-K_2O/ha.

RESULTS AND DISCUSSION

Plant Height

Results revealed that there were no significant differences among the treatments with regards to final plant height of as shown in Table 1. The height of the treatment plants ranged from 83.15 to 83.90 centimeters.

Haulm weight

Table 2 shows that there were no significant differences in the haulm weight of the treatment plants. However, plants applied with 210-140-140 kg N-P_2O_5-K_2O/ha had heavier haulms.

Table 1. Plant height

TREATMENT (kg N-P_2O_5-K_2O/ha)	MEAN (cm)
210-140-140	83.50[a]
140-140-140	83.25[a]
140-140-210	83.90[a]
210-140-210	83.15[a]
140-140-140 +3 t/ha chicken dung	83.75[a]

Means followed by a common letter are not significantly different at 5% level (DMRT).

Table 2. Haulm weight

TREATMENT (kg N-P_2O_5-K_2O /ha)	MEAN (g)
210-140-140	417.49[a]
140-140-140	376.32[a]
140-140-210	386.27[a]
210-140-210	388.21[a]
140-140-140 +3 t/ha chicken dung	392.96[a]

Means followed by a common letter are not significantly different at 5% level (DMRT).

Days to Maturity

Plants applied with either 140-140-140 or 140-140-210 kg N-P_2O_5-K_2O/ha significantly matured earlier at 89 days as shown in Table 3.

Table 3. Days to maturity

TREATMENT (kg N-P_2O_5-K_2O/ha)	MEAN
210-140-140	90.50[a]
140-140-140	89.00[b]
140-140-210	89.00[b]
210-140-210	90.50[a]
140-140-140 +3 t/ha chicken dung	91.00[a]

Means followed by a common letter are not significantly different at 5% level (DMRT).

Weight of Classified Tubers

In Table 4, there were no significant differences in the weight of marketable tubers classified into sizes as affected by the fertilizers applied. However, application of 140-140-210 kg N-P_2O_5-K_2O/ha tended to increase the weight of bigger size tubers.

Table 4. Weight of tubers classified according to sizes

TREATMENT (kg N-P_2O_5-K_2O/ha)	CLASSIFICATION (kg/5 m^2 plot)							
	MARBLE	SMALL	MED	BIG	L	XL	SUPER	JUMBO
210-140-140	1.13[a]	1.54[a]	2.46[a]	0.93	1.27	1.43	1.06[a]	2.67[a]
140-140-140	1.20[a]	1.71[a]	2.09[a]	a	a	a	1.26[a]	2.31[a]
140-140-210	0.85[a]	1.08[a]	2.53[a]	0.79	1.02	1.06	1.28[a]	2.76[a]
210-140-210	1.14[a]	1.53[a]	2.54[a]	a	a	a	1.25[a]	2.26[a]
140-140-140 +3 t/ha chicken dung	1.06[a]	1.58[a]	2.61[a]	1.05 a	0.98 a	1.28 a	0.96[a]	1.68[a]
				1.19 a	1.18 a	0.72 a		
				1.22 a	1.54 a	1.28 a		

Means followed by a common letter within a column are not significantly different at 5% level (DMRT).

Legend: Marble = 37-43g, small= 44-50g, medium= 51-77g, big= 78-84g, large= 85-98g, extra large= 99-105g, super= 106-125g, jumbo 126g-above

Number of Classified Tubers

Table 5 shows that there were no significant differences in the number of marketable tubers classified into sizes. However, greater number of extra large tubers was obtained with the app1ication of 210-140-140 kg N-P_2O_5-K_2O /ha, super tubers with 140-140-210 kg N-P_2O_5-K_2O/ha and jumbo tubers with 140-140-140 kg N-P_2O_5-K_2O/ha.

Table 5. Number of tubers classified according to sizes

TREATMENT (kg N-P_2O_5-K_2O/ ha)	CLASSIFICATION (per 5 m^2 plot)							
	Marble	Small	M	B	L	XL	Super	Jumbo
210-140-140	45.50[a]	36.25[a]	38.75[a]	14.25[a]	14.50[a]	14.25[a]	9.50[a]	17.25[a]
140-140-140	47.00[a]	37.00[a]	35.00[a]	10.25[a]	12.00[a]	11.75[a]	12.00[a]	15.25[a]
140-140-210	33.25[a]	23.25[a]	39.25[a]	13.50[a]	10.75[a]	12.50[a]	12.75[a]	19.50[a]
210-140-210	46.25[a]	35.00[a]	40.24[a]	14.75[a]	13.25[a]	7.50[a]	11.50[a]	14.50[a]
140-140-140 +3 t/ha chicken dung	45.50[a]	33.50[a]	41.25[a]	15.50[a]	17.50[a]	13.00[a]	8.00[a]	13.75[a]

Means followed by a common letter within a column are not significantly different at 5% level (DMRT).

Legend: Marble = 37-43g, small= 44-50g, medium= 51-77g, big= 78-84g, large= 85-98g, extra large= 99-105g, super= 106-125g, jumbo 126g-above

Tuber Yield

There were no significant differences in the marketable, non-marketable and total yield as affected by rates of fertilizers applied as shown in Table 6. However, greater marketable tubers were noted with the application of higher nitrogen and lower phosphorus and potassium levels at 210-140-140 kg N-P_2O_5-K_2O/ha.

Plants applied with 210-140-140 kg N-P_2O_5-K_2O/ha had better haulm development for photosynthesis, thus resulting to higher marketable tuber yield.

Computed Marketable Yield

There were no significant differences in the computed yield as shown in Table 7. However, the highest computed marketable yield was obtained from plants applied with 210-140-140 kg N-P_2O_5-K_2O/ ha at 24, 835.00 kg/ha.

Table 6. Tuber yield

TREATMENT (kg N-P_2O_5-K_2O/ha)	YIELD (kg/5 m^2 plot)		
	MARKETABLE	NON-MARKETABLE	TOTAL
210-140-140	12.42[a]	0.48[a]	12.89[a]
140-140-140	11.49[a]	0.51[a]	12.00[a]
140-140-210	11.79[a]	0.47[a]	12.26[a]
210-140-210	11.88[a]	0.49[a]	12.28[a]
140-140-140 +3 t/ha chicken dung	11.92[a]	0.59[a]	12.51[a]

Means followed by a common letter within a column are not significantly different at 5% level (DMRT).

Table 7. Computed marketable yield

TREATMENT (kg N-P_2O_5-K_2O/ha)	MEAN (kg/ha)
210-140-140	24, 835.00[a]
140-140-140	22, 975.00[a]
140-140-210	23, 575.00[a]
210-140-210	23, 580.00[a]
140-140-140 +3 t/ha chicken dung	23, 845.00[a]

Means followed by a common letter are not significantly different at 5% level (DMRT).

Tuber Dry Matter Content

Table 8 shows that significantly higher dry matter content of tubers at 24.16% was obtained with the application of lower nitrogen and phosphorus and higher amount of potassium at 140-140-210 kg N-P_2O_5-K_2O/ha. This dry matter meets the standard for processing potatoes.

Dry matter content of potatoes for processing is of great importance. Dry matter content of potatoes is acceptable when it is from 17.19% to 29.99% while the least acceptable range is from 15.10% to 16.44% dry matter (Ludwig, 1985). HARRDEC (1996) emphasized also that potatoes should have a dry matter of 21% for processing for best quality.

Table 8. Tuber dry matter content

TREATMENT (kg N-P_2O_5-K_2O/ha)	MEAN (%)
210-140-140	22.32[b]
140-140-140	22.64[b]
140-140-210	24.16[a]
210-140-210	22.64[b]
140-140-140 +3 t/ha chicken dung	22.58[b]

Means followed by a common letter are not significantly different at 5% level (DMRT).

Soil Analysis

The composition of the soil in the experimental field prior to application of different fertilizer rates is shown in table 9.

Table 9. Soil analysis

	N, %	P, ppm	K, ppm	OM, %	pH
Initial	0.05	94	300	1.0	5.91

Meteorological Data

The meteorological data during the study period is shown in Table 10. Rainfall ranged from 0.72 mm to 3.40 mm; relative humidity, 83.63% - 87.00%; minimum temperature, 10.7 ^{o}C - 15.50 ^{o}C; maximum temperature, 23.90 ^{o}C – 24.72 ^{o}C; and sunshine duration, 267.16 min – 304.18 min.

Cost and Return Analysis

Table 11 shows that the highest return on investment at 62.78 % was obtained with the application of 210-140-140 kg N-P_2O_5-K_2O/ha followed by the application of 140-140-140 kg N-P_2O_5-K_2O/ha.

Table 10.Meteorological data

Month	Rainfall (mm)	RH (%)	Temperature (^{0}C)		Sunshine duration (min)
			Min	Max	
November	0.72	87.00	15.50	24.72	267.16
December	0.72	86.90	14.48	24.66	227.71
January	1.40	83.63	13.10	24.15	296.95
February	3.40	86.60	10.70	23.9	304.18

Table 11. Cost and return analysis

	TREATMENT				
ITEM	T_1	T_2	T_3	T_4	T_5
Marketable yield kg/ $5m^2$ plot	12.42	11.49	11.79	11.88	11.92
Inputs					
Labor	20.50	20.50	20.50	20.50	20.50
Planting materials	66.67	66.67	66.67	66.67	66.67
Fertilizers	17.86	15.50	17.86	20.21	27.50
Insecticides	25.67	25.67	25.67	25.67	25.67
Fungicides	37.50	37.50	37.50	37.50	37.50
Total Expenses	168.20	165.84	168.20	170.55	178.04
Gross sales	273.80	256.22	245.10	252.58	228.95
Net income	105.6	90.38	76.90	82.03	49.09
ROI (%)	62.78	54.50	45.72	48.10	27.57
Rank	1	2	4	3	5

Legend (kg N-P_2O_5-K_2O/ha): T_1=210-140-140, T_2=140-140-140, T_3=140-140-210, T_4=210-140-210, T_5=140-140-140 + 3 t/ha chicken dung

The Php selling price was: Marble= 2.00 per piece, and per kilogram: Small= 8.00, Medium=10.00, Big=12.00, Large=15.00, Extra large=18.00, Super=20 and Jumbo=25

Pictorial Presentation

Figure 1. Overview of the experiment field two weeks from planting

Figure 2. Tuber Yield

2a. Tubers classified according to sizes from plants applied with 210-140-140 kg $N\text{-}P_2O_5\text{-}K_2O$/ha

2b. Tubers classified according to sizes from plants applied with 140-140-140 kg $N\text{-}P_2O_5\text{-}K_2O$/ha

2c. Tubers classified according to sizes from plants applied with 140-140-210 kg N-P_2O_5-K_2O/ha

2d. Tubers classified according to sizes from plants applied with 210-140-210 kg N-P_2O_5-K_2O/ha

2e. Tubers classified according to sizes from plants applied with 140-140-140 kg N-P_2O_5-K_2O/ha plus 3 t/ha chicken dung

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted primarily to determine the effect of varying rates nitrogen and potassium on the growth and yield performance of potato, establish the appropriate level of nitrogen and potassium that will enhance growth, yield and tuber dry matter accumulation and determine the economics of using different fertilizer rates in potato production. It was conducted at the Horticulture Experiment Field, Benguet State University, La Trinidad, Benguet from November 2011 to February 2012.

Growth in plant height and haulm weight did not significantly differ among treatment plants and so with the number and weight of tubers classified according to sizes including yield. However, marketable yield tended to increase at 24.83 t/ha with the application of higher nitrogen rate at 210-140-140 kg N-P_2O_5-K_2O/ha. Tuber dry matter at 24.16% was significantly higher with higher potassium level at 140-140-210 kg N-P_2O_5-K_2O/ha. The return on investment was highest at 62.78% with the application of 210-140-140 kg N-P_2O_5-K_2O/ha.

Conclusion

Based on the results, it is concluded that application of 210-140-140 kg N-P_2O_5-K_2O/ha could increase the marketable yield and correspondingly increase the return on investment. Higher dry matter content of tubers could be obtained with the application of 140-140-210 kg N-P_2O_5-K_2O/ha.

Recommendation

It is therefore recommended to apply 210-140-140 kg N-P_2O_5-K_2O/ha on potato to have a higher marketable yield and return on investment. For potato intended for processing, application of 140-140-210 kg N-P_2O_5-K_2O/ha could increase the tuber dry matter content.

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