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Response of chickpea (*Cicer arietinum L.*) to different sources of organic fertilizers under Philippine condition

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ABSTRACT . Growing chickpea in the Philippines is a new enterprise and the demand is through importation. Chickpeas have an entrenched place in Filipino food culture, which developed during the Spanish colonial era. The study was conducted at Benguet State University, La Trinidad, Benguet from November 2009 to March 2010 to determine the growth and yield of chickpea varieties as affected by different sources of organic fertilizers. The treatments included 6 chickpea varieties and 4 organic fertilizers. The phenological attributes of chickpea were not significantly different among the various applications of organic fertilizers except for weight of 100 seeds and seed yield. ICCV 93952 (*desi*) applied with BSU compost (2N - 2.7P - 2.4K) and *Kabuli* variety ICCV 2 fertilized with Sagana 100 (7N-7P 7K) produced the highest seed yield of 2217 kg/ha and 2216 kg/ha, respectively. The study clearly indicates that organic fertilizers have influenced the productivity performance of chickpea.

Keywords : *Chickpea, Cicer arietinum, organic fertilizer, varieties, phenological attributes*

INTRODUCTION

Chickpea (*Cicer arietinum L.)* is an ancient crop that is widely grown in the rainfed areas of the semi-arid tropics with little or no fertilizer application (Patel *et al.*, 1989). Chickpea grows perfectly in optimum climatic conditions of 18-26°C (day) and 17-21°C (night) temperatures with annual rainfall of 600-1000 mm. However, some cultivars can tolerate temperatures as low as 9.5°C in early stages even with daily temperature fluctuations in cold nights with dewfall (Smithson *et al.*, 1985). Chickpea is an important pulse crop in India, Pakistan, Bangladesh and the UK; they are full of protein (23%) and starch (47%) (Gaur *et al.*, 2010). In the Philippines, growing chickpea is a new venture and the demand of chickpea by the Filipinos is through importation. Chickpeas have an entrenched place in Filipino food culture, which developed during the Spanish colonial era. Traditionally, they are used in *halo halo*, a local dessert, a stew known as *menudo*, sausage and chickpea dish known as *callos*, and other dishes, *e.g.* paella, soups, salads and some Spanish dishes that are cooked in some homes. They are also preserved in syrup and eaten as sweet confectionery items. Moreover, the supply of chickpea in the Philippines depends on importation from chickpea producing countries. Canned chickpeas are imported from the USA (S&W brand), Molinera (Italy) and Malaysia (Kimball brand by Campbell Soup). These products have very small niches within the existing canned chickpea market. According to retailers, they are mainly purchased by expatriates and high income local consumers (Stanton, Emms and Sia Consulting Services, 2010).

Renewed concern about the environment has stipulated interest in the use of organic fertilizers. Organic agriculture is becoming more popular because consumers are demanding healthful and environmentally-friendly food. Organic farming is an agricultural system that seeks to provide fresh, tasty and authentic food while respecting natural life-cycle systems (www.organic-farming.europa.eu). Soil organic matter contributes greatly to soil quality and plant health. Organic fertilizers are made from materials derived from animal manure, compost, bone meal and blood meal. Organic fertilizers can be more expensive and less accessible than inorganic fertilizers. However, organic fertilizers don't buildup toxicity in the soil, as long as the amount of organic material incorporated into the soil is fully decomposed unlike the inorganic fertilizers (Marchain *et al.*, 1991). Organic matter provides the soil with the right components to build soil structure, will help sandy soils hold more water and nutrients and will aid the ability of a heavy clay soil to drain excessive soil moisture by adding porosity, something that inorganic fertilizers really cannot do (Balco, 1986). Organic fertilizers do not contain nutrients in easily usable form. When they are mixed into the soil, the microorganisms like bacteria that are in the soil, have to work on the fertilizer, break it up and release the nutrients. This is a slow process and so there is no danger that too many nutrients are ever available to the plant. As such there is no chance for a 'plant burn' when organic fertilizers are used. The majority of nitrogen supplying organic fertilizers contains insoluble nitrogen and act as a slow-release fertilizer. By their nature, organic fertilizers increase physical and biological nutrient storage mechanisms in soils, mitigating risks of over-fertilization. Organic fertilizer nutrient content, solubility, and nutrient release rates are typically much lower than mineral (inorganic) fertilizers (Prasad *et al.*, 2004). Hence, the study was conducted to

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determine the growth and yield performance of chickpea as affected by different organic fertilizers.

MATERIALS AND METHODS

A field experiment was conducted during the winter season of 2009 and 2010 with temperature ranging from 21.05°C to 22.95°C having a relative humidity of 82.75% to 88% at Balili Experimental Station, Benguet State University, La Trinidad, Benguet, Philippines. The experiment was laid out in a Randomized Complete Block Design (RCBD) in factorial arrangement with the varieties as Factor A and the different organic fertilizers as Factor B. There were three replications per treatment with three sample plants in a 1 m x 3 m plot. Soil analysis was done before planting. The treatments consisted of two types of chickpea (*desi* and *kabuli*) with three cultivars for each type (*desi* – ICCV 93952, ICCV 93954, ICCV 06102; *kabuli* – ICCV 2, ICCV 95334, ICCV 07037); and organic fertilizer (unprocessed chicken manure - 6.6N - 2.7P - 1.5K; BSU compost - 2N - 2.7P - 2.4K; processed chicken manure - 4N - 4P - 4K; Sagana 100 (commercial) - 7N - 7P - 7K). The seeds were sown 30 cm between rows and 20 cm between hills. The quantity of organic fertilizer applied was based on recommended rate of 5 tons/ha. Hilling-up operation was done one month after planting. Other recommended agronomic practices during its vegetative and reproductive stage were followed uniformly to all the treatments. Data on days to 50% flowering, plant height at 50% flowering (cm), days to harvesting, number of lateral branches, number of pods/plant, number of filled and unfilled pods/plant, weight of 100-seeds (g), and yield per plant (g) were collected on 5 sample plants within each treatment. Total seed yield (kg/ha) was computed on plot basis. To detect the direct and interactive effects of the varieties and fertilizer treatments, analysis of variance for split plot design was used to determine the best treatment combination in increasing seed yield of chickpea.

RESULTS AND DISCUSSIONS

Days to 50% flowering

Effect of variety : There was significant difference (P<0.05) on the number of days to 50% flowering by the different varieties of chickpea as shown in **Table 1.** The *kabuli* varieties (ICCV 2, ICCV 95334, and ICCV 07037) were the earliest to reach 50% flowering than *desi* varieties. The latest to reach 50% flowering was *desi* variety ICCV 93952 at 72 day (**Table 2**).

Effect of organic fertilizer : There was no significant difference (P<0.05) on the days to 50% flowering of chickpea as influenced by the different organic fertilizers (Table 1).

Interactive effect of variety and organic fertilizer : The study revealed that no significant difference (P<0.05) among the chickpea varieties was observed as affected by the interactive effect of variety and organic fertilizer (Table 1).

Plant height at 50% flowering (cm)

Effect of variety : Table 1 shows that there was significant difference (P<0.05) on the plant height among the chickpea varieties (Table 1). Results show that ICCV 93952 (*desi*) had the tallest plants at 53.05 cm while ICCV 07037 (*kabuli*) had the shortest at 33.10 cm. Furthermore, the *desi* varieties produced taller plant than *kabuli* varieties (Table 2).

Effect of organic fertilizer : There was no significant difference (P<0.05) on the plant height of chickpea as affected by different organic fertilizers (Table 1).

Interactive effect of variety and organic fertilizer. Study revealed no significant difference (P<0.05) on the plant height of chickpea as affected by the interaction between the different organic fertilizers and varieties (Table 1).

Number of lateral stems : Table 1 revealed that there were no significant differences (P<0.05) among the chickpea varieties on the number of lateral stems as influenced by either the effect of variety, effect of organic fertilizer or the interactive effect of variety and organic fertilizer on chickpea.

Number of pods/plant : The study showed that no significant differences (P<0.05) among the chickpea varieties were observed on the number of pods/plant as affected by either the effect of variety, effect of organic fertilizer or the interactive effect of variety and organic fertilizer (Table 1).

Table 1. Direct and interactive effect of variety and organic fertilizer on the agronomic and yield and yield traits of chickpea varieties at 5% level of significance

Treatment	Days to 50% flowering (no.)	Plant height at 50% flowering (cm)	Lateral stems (no.)	Pods			Weight of 100-seeds	Yield per	
				per plant (no.)	Filled pods (no.)	Unfilled pods (no.)		Plant (g)	Hectare (kg)
Effect of variety	<.0001**	<.0001**	0.695ns	0.449ns	0.755ns	0.464ns	<.0001**	<.0001*	<.0001**
Effect of organic fertilizer	0.216ns	0.454ns	0.362ns	0.385ns	0.797ns	0.439ns	0.039*	<.003*	<.0001**
Interactive effect of variety and organic fertilizer	0.479ns	0.406ns	0.491ns	0.467ns	0.365ns	0.455ns	<.0001**	<.0001*	<.0001**

** - highly significant; * - significant; ns – not significant

Table 2. Mean attributes of chickpea as influenced by the direct and interactive effects of variety and organic fertilizer

Agronomic trait	Factor	Treatment	Mean
Days from planting to 50% flowering (no.)	Effect of variety	ICCV 93952	72.31
		ICCV 93954	67.30
		ICCV 06102	70.53
		ICCV 2	47.31
		ICCV 95334	48.08
		ICCV 07037	47.56
Plant height at 50% flowering (cm)	Effect of variety	ICCV 93952	53.05
		ICCV 93954	48.12
		ICCV 06102	49.08
		ICCV 2	40.59
		ICCV 95334	45.76
		ICCV 07037	33.10
Weight of 100 seeds (g)	Effect of variety	ICCV 93952	26.13
		ICCV 93954	24.23
		ICCV 06102	24.26
		ICCV 2	24.22
		ICCV 95334	43.68
		ICCV 07037	34.50
	Effect of organic fertilizer	Chicken manure unprocessed	29.68
		BSU compost	29.48
		Chicken manure processed	28.68
		Sagana 100	30.17
	Interactive effect of variety and organic fertilizer	ICCV 93952 + chicken manure unprocessed	29.90
		ICCV 93952 + BSU compost	26.27
		ICCV 93952 + chicken manure processed	25.10
		ICCV 93952 + Sagana 100	23.23
		ICCV 93954 + chicken manure unprocessed	22.57
		ICCV 93954 + BSU compost	23.67
		ICCV 93954 + chicken manure processed	24.77
		ICCV 93954 + Sagana 100	25.93
		ICCV 06102 + chicken manure unprocessed	24.93
		ICCV 06102 + BSU compost	23.67
		ICCV 06102 + chicken manure processed	23.07
		ICCV 06102 + Sagana 100	25.37
		ICCV 2 + chicken manure unprocessed	22.63
		ICCV 2 + BSU compost	24.30
		ICCV 2 + chicken manure processed	22.47
		ICCV 2 + Sagana 100	27.47
		ICCV 95334 + chicken manure unprocessed	41.17
		ICCV 95334 + BSU compost	43.43
		ICCV 95334 + chicken manure processed	43.20
		ICCV 95334 + Sagana 100	46.90
		ICCV 07037 + chicken manure unprocessed	36.87
		ICCV 07037 + BSU compost	35.53
		ICCV 07037 + chicken manure processed	33.50
		ICCV 07037 + Sagana 100	32.10
Seed yield/plant (g)	Effect of variety	ICCV 93952	66.31
		ICCV 93954	60.61
		ICCV 06102	61.97
		ICCV 2	52.25
		ICCV 95334	24.08
		ICCV 07037	59.33
	Effect of organic fertilizer	Chicken manure unprocessed	52.19
		BSU compost	57.06
		Chicken manure processed	51.29
		Sagana 100	55.81
	Interactive effect of variety and organic fertilizer	ICCV 93952 + chicken manure unprocessed	60.53
		ICCV 93952 + BSU compost	82.88
		ICCV 93952 + chicken manure processed	63.24
		ICCV 93952 + Sagana 100	58.57
		ICCV 93954 + chicken manure unprocessed	59.66
		ICCV 93954 + BSU compost	73.37
		ICCV 93954 + chicken manure processed	68.48
		ICCV 93954 + Sagana 100	40.94
		ICCV 06102 + chicken manure unprocessed	55.33
		ICCV 06102 + BSU compost	48.68
		ICCV 06102 + chicken manure processed	63.79
		ICCV 06102 + Sagana 100	80.08
		ICCV 2 + chicken manure unprocessed	47.80

Contd...

Agronomic trait	Factor	Treatment	Mean
		ICCV 2 + BSU compost	57.21
		ICCV 2 + chicken manure processed	46.71
		ICCV 2 + Sagana 100	57.26
		ICCV 95334 + chicken manure unprocessed	12.30
		ICCV 95334 + BSU compost	30.60
		ICCV 95334 + chicken manure processed	18.52
		ICCV 95334 + Sagana 100	34.89
		ICCV 07037 + chicken manure unprocessed	77.54
		ICCV 07037 + BSU compost	49.65
		ICCV 07037 + chicken manure processed	46.99
		ICCV 07037 + Sagana 100	63.14
Seed yield/ha (kg)	Effect of variety	ICCV 93952	2064.44
		ICCV 93954	1661.22
		ICCV 06102	1876.64
		ICCV 2	1870.83
		ICCV 95334	684.95
		ICCV 07037	1455.03
	Effect of organic fertilizer	Chicken manure unprocessed	1625.41
		BSU compost	1522.20
		Chicken manure processed	1491.41
		Sagana 100	1769.72
	Interactive effect of variety and organic fertilizer	ICCV 93952 + chicken manure unprocessed	2115.89
		ICCV 93952 + BSU compost	2217.89
		ICCV 93952 + chicken manure processed	1841.78
		ICCV 93952 + Sagana 100	2082.22
		ICCV 93954 + chicken manure unprocessed	1810.11
		ICCV 93954 + BSU compost	1825.55
		ICCV 93954 + chicken manure processed	1725.89
		ICCV 93954 + Sagana 100	1283.33
		ICCV 06102 + chicken manure unprocessed	1926.22
		ICCV 06102 + BSU compost	1668.55
		ICCV 06102 + chicken manure processed	1809.11
		ICCV 06102 + Sagana 100	2102.66
		ICCV 2 + chicken manure unprocessed	1921.00
		ICCV 2 + BSU compost	1442.89
		ICCV 2 + chicken manure processed	1903.11
		ICCV 2 + Sagana 100	2216.33
		ICCV 95334 + chicken manure unprocessed	314.11
		ICCV 95334 + BSU compost	699.11
		ICCV 95334 + chicken manure processed	880.89
		ICCV 95334 + Sagana 100	845.67
		ICCV 07037 + chicken manure unprocessed	1665.11
		ICCV 07037 + BSU compost	1279.22
		ICCV 07037 + chicken manure processed	787.66
		ICCV 07037 + Sagana 100	2088.11

Number of filled pods/plant : No significant differences ($P<0.05$) among the chickpea varieties were observed on the number of filled pods as influenced by the effect of variety, effect of organic fertilizer, and interactive effect of variety and organic fertilizer (Table 1).

Number of unfilled pods/plant : A shown in Table 1, the number of unfilled pods per plant was not significantly different ($P<0.05$) among the chickpea varieties either by the effect of variety, effect of organic fertilizer or the interactive effect of variety and organic fertilizer.

Weight of 100-seeds (g)

Effect of variety : Results showed that weight of 100-seeds were significantly different ($P<0.05$) among the chickpea varieties (Table 1). The *kabuli* variety ICCV 95334 had the highest seed weight at 43.68 g/100 seeds while ICCV 2 had the lowest seed weight of 24.22 g. For *desi* variety, ICCV 93952 give the highest seed weight at 26.13 g and ICCV 06102 and ICCV 93954 had the least weight of 24.26 g and 24.23 g, respectively (Table 2).

Effect of organic fertilizer : The study revealed that weight of 100-seeds of the different chickpea varieties were significantly influenced ($P<0.05$) by the different application of organic fertilizers (Table 1). Chickpea fertilized with Sagana 100 (7N - 7P - 7K) give the highest weight at 30.17 g/100 seeds while processed chicken manure (4N - 4P - 4K) had the least weight at 28.68 g (Table 2).

Interactive effect of variety and organic fertilizer : Analysis revealed that significant differences ($P<0.05$) in the weight of 100 seeds of chickpea as affected by the interaction between the different organic fertilizers applied and different varieties used (Table 1). Results showed that ICCV 95334 (*kabuli*) applied with Sagana 100 (7N - 7P - 7K) produced the heaviest weight (46.90 g) while ICCV 2 (*kabuli*) applied with

processed chicken manure (4N - 4P - 4K) produced the least seed weight of 22.47 g (Table 2).

Seed yield per plant (g)

Effect of variety : Study showed that there was significant difference ($P<0.05$) among the chickpea varieties on plant yield (Table 1). ICCV 93952 (*desi*) produced the highest plant yield of 66.47 g while ICCV 95334 (*kabuli*) had the lowest plant yield of 24.08 g (Table 2).

Effect of organic fertilizers : Table 1 revealed that there were significant differences ($P<0.05$) on yield per plant of chickpea as influenced by different organic fertilizers (Table 1). Results showed that the application of BSU compost (2N - 2.7P_2 - 2.4K) give the highest plant yield of 57.06 g while the application of processed chicken manure (4N - 4P - 4K) produced the lowest plant yield of 51.29 g (Table 2).

Interactive effect of variety and organic fertilizer : There was a significant difference ($P<0.05$) on the plant yield as influenced by the interaction between the different organic fertilizers and varieties (Table 1). Results showed that ICCV 93952 (desi) applied with BSU compost (2N - 2.7P - 2.4K) produced the highest plant yield of 82.88 g whereas ICCV 95334 (*kabuli*) fertilized with unprocessed chicken manure (6.6N - 2.7P - 1.5K) had the lowest plant yield of 12.30 g (Table 2).

Seed yield per hectare (kg)

Effect of variety : Table 1 showed that seed yield was significantly different ($P<0.05$) among chickpea varieties. ICCV 93952 (*desi*) give the highest seed yield at 2064.44 kg/ha while the least producer was ICCV 95334 (*kabuli*) at 684.95 kg/ha (Table 2).

Effect of organic fertilizers : There was significant difference ($P<0.05$) on the seed yield of chickpea as affected by the different organic fertilizers (Table 1). Results showed that the application of Sagana 100 (7N - 7P - 7K) produced the highest seed yield of 1769.72 kgs/ha whereas the application of processed chicken manure give the lowest seed yield of 1491.41 kgs/ha (Table 2).

Interactive effect of variety and organic fertilizer : The interactive effect of variety with organic fertilizer has significantly influenced ($P<0.05$) the seed yield of chickpea (Table 1). *Desi* variety ICCV 93952 with application of BSU compost (2N - 2.7P - 2.4K) and *kabuli* variety ICCV 2 fertilized with Sagana 100 (7N - 7P - 7K) produced the highest seed yield of 2217 kg/ha and 2216 kg/ha, respectively while *kabuli* variety ICCV 95334 applied with unprocessed chicken manure (6.6N - 2.7P - 1.5K) produced the lowest seed yield of 314.11 kg/ha (Table 2).

CONCLUSIONS

The agronomic and yield traits of the different chickpea varieties were not significantly different among the various applications of organic fertilizers. However, there was a significant difference on the seed yield among the different varieties of chickpea as influenced by the effect and the interactive effect of varieties with the different application of organic fertilizers. With the six varieties and four organic fertilizers tested, ICCV 93952 (*desi*) applied with BSU compost (2N - 2.7P - 2.4K) produced the highest seed yield (2217 kg/ha) while *kabuli* variety ICCV 2 fertilized with Sagana 100 (7N - 7P - 7K) had the highest seed yield of 2216 kg/ha. The study clearly indicates that organic fertilizers due to its carbon based compounds have influenced the seed weight (Mekki and Ahmed, 2005) of chickpea which increases the productivity performance of the plants.

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