

BIBLIOGRAPHY

ALICAN, GERALDINE A. MAY 2013. Yield of Chickpea (*Cicer arietinum* L.) as affected by row orientation grown in between Citrus trees. Benguet State University, La Trinidad, Benguet.

Adviser: Franklin G. Bawang, Msc.

ABSTRACT

The study was conducted at the Benguet State University, Horticulture Laboratory Area, La Trinidad, Benguet from November 2012 to March 2013 to determine the best chickpea variety grown as intercrop in between citrus trees, to determine the best row orientation in the yield of chickpea; and to determine the interaction effect of variety and row orientation on the growth and yield of chickpea.

Findings showed significant differences among the different row orientations followed in this study with regards to average plant height at flowering, average number of pods per plant, biomass weight and weight of 100 seeds. Chickpea planted in a northeast to southwest row orientation produced the tallest plants at flowering, highest number of pods per plant, heaviest biomass and the heaviest weight of 100 seeds. Chickpea planted in east to west row orientation were the earliest to mature.

Among the different varieties of chickpea grown in the study, ICCV 95334 (Kabuli Type) was the earliest to reach 50% flowering and mature and had the highest harvest index. ICCV 93954 (Desi type) produced the tallest plants at flowering, had the highest



number of pods per plant, weight of marketable seeds per plot, highest seed yield per plot, and computed seed yield per hectare (t/ha), heaviest biomass and weight of 100 seeds.

ICCV 93954 (Desi type) planted on a northwest to southeast row orientation produced the highest weight of marketable seed and total seed yield, computed seed yield per hectare (t/ha) and heaviest biomass.

Based on the findings of the study, ICCV 93954, a Desi type of chickpea can be productively grown in a northeast to southwest row orientation under La Trinidad, Benguet condition.



RESULTS AND DISCUSSION

Number of Days from Planting to 50% Flowering

Effect of variety. Highly significant differences were observed on the number of days from planting to 50% flowering of chickpea as affected by the different varieties of chickpea used. ICCV 95334 (Kabuli type) were the earliest to reach 50% flowering with a mean of 51.69 days from planting while ICCV 93954 (Desi type) took longer days to attain 50% flowering having a mean of 66.13 days from planting. Findings show that Kabuli type chickpea produced flowers earlier than the desi type cultivars (Table 1 and Figure 5).

Effect of row orientation. There were no significant differences noted on the number of days from planting to 50% flowering of chickpea as affected by the different row orientation used. The number of days from planting to 50% flowering ranged from 57.63 to 59.88 days. Results showed that different row orientation did not affect the number of days from planting to 50% flowering.

Interaction effect. The interaction effects between the different row orientation used and different varieties of chickpea used in the number of days from planting to 50% flowering of chickpea were significant. Results revealed that ICCV 95334 (Kabuli type) planted in a northwest to southeast row orientation flowered earlier after 48.25 days while ICCV 93954 (Desi type) planted in north to south row orientation had more days to reach 50% flowering which was after a mean of 67 days.



Table 1. Number of days from planting to 50% flowering of two varieties of chickpea planted in different row orientations

TREATMENT	Days from planting to 50% flowering
<u>Variety (A)</u>	
ICCV 95334 “Kabuli type”	51.69 ^b
ICCV 93954 “Desi type”	66.13 ^a
<u>Row Orientation (B)</u>	
East to West Direction	59.63 ^a
North to South Direction	58.5 ^a
Northeast to Southwest Direction	59.88 ^a
Northwest to Southeast Direction	57.63 ^a
A x B	Significant
CV (%)	8.38

Means with a common letter are not significantly different at 5% DMRT

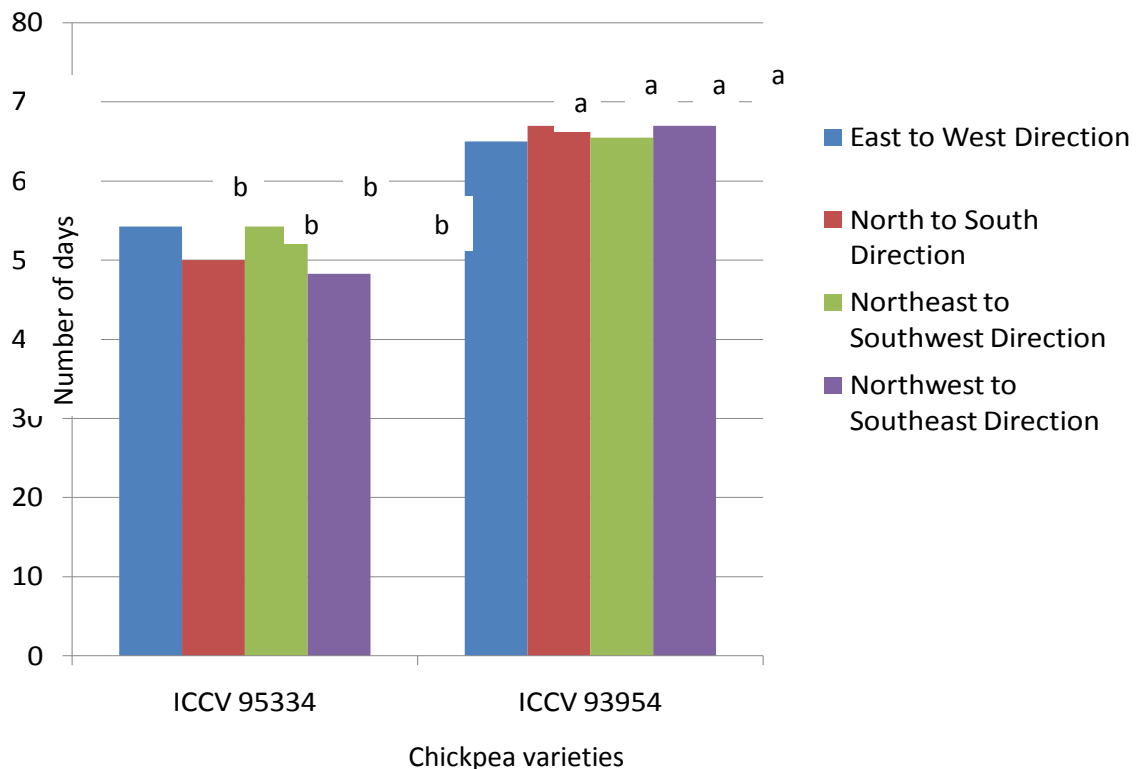


Figure 8. Number of days from planting to 50% flowering



Number of Days from Planting to Maturity

Effect of variety. Highly significant differences were observed on the number of days from planting to maturity of chickpea as affected by the different varieties of chickpea grown. ICCV 95334 (Kabuli type) were the earliest to mature with a mean of 141.25 days from planting while ICCV 93954 (Desi type) were the latest to mature with a mean of 154.13 days from planting. Results showed that Kabuli type varieties matured earlier than desi type chickpea (Table 2 and Figure 6).

Bautista *et al.* (1983) pointed that each variety contains a set of genetic make-up which determines the earliness of maturity and attributed to the varietal characteristics of the different cultivars.

Effect of row orientation. Differences obtain in the number of days from planting to maturity of chickpea as affected by the different row orientation used were highly significant. Chickpea plants grown in a northeast to southwest row orientation were the latest to mature with a mean of 155.5 days from planting, while chickpea plants grown in east to west row orientation were the earliest to mature with a mean of 142 days from planting.

Interaction effect. The interaction effects between the different row orientation used and different varieties of chickpea used on the number of days from planting to maturity were significant. Results revealed that ICCV 93954 (Desi type) planted in northwest to southeast row orientation were the latest to mature after 160 days from planting while ICCV 95334 (Kabuli type) planted in east to west row orientation were the earliest to mature after 135 days from planting.



Table 2. Number of days from planting to maturity of two variety planted in different row orientation

TREATMENT	Days from planting to maturity
<u>Variety (A)</u>	
ICCV 95334 “Kabuli type”	141.25 ^b
ICCV 93954 “Desi type”	154.13 ^a
<u>Row Orientation (B)</u>	
East to West Direction	142 ^{ab}
North to South Direction	143.25 ^b
Northeast to Southwest Direction	155.5 ^a
Northwest to Southeast Direction	150 ^{ab}
A x B	Significant
CV (%)	4.80

Means with a common letter are not significantly different at 5% DMRT

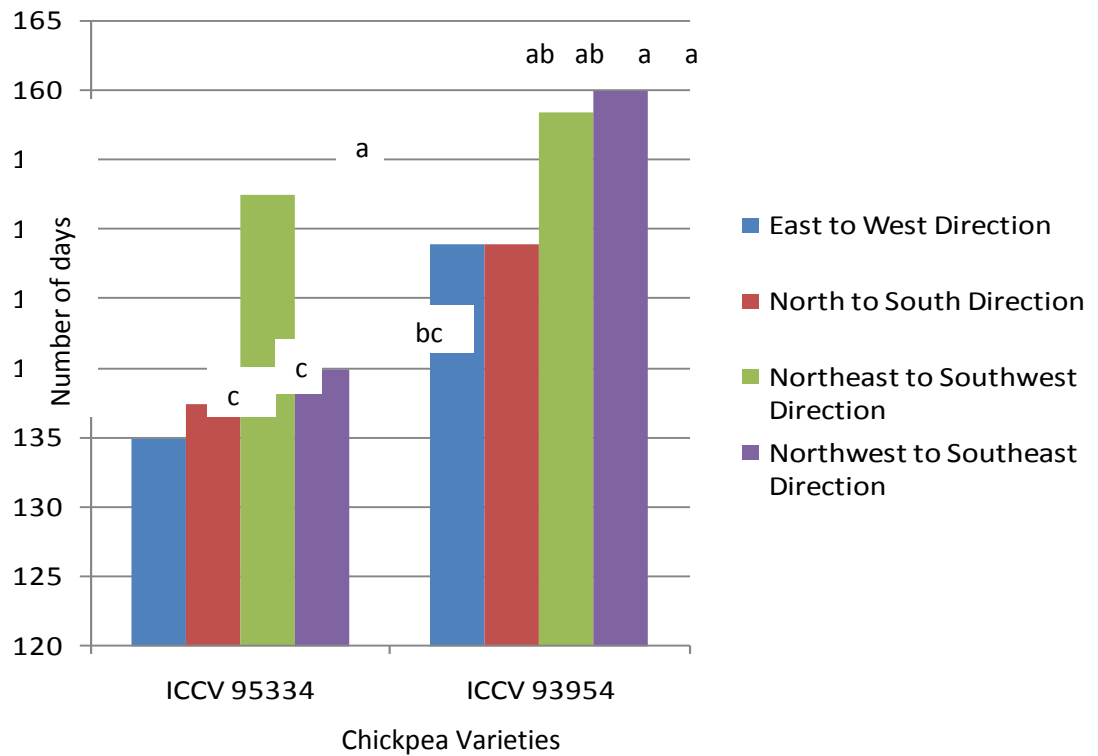


Figure 9. Number of days from planting to maturity
Average Plant Height at Flowering



Effect of variety. Differences obtained in the average plant height at flowering of chickpea as affected by the different varieties used were highly significant (Table 2). ICCV 93954 (Desi type) were the tallest plants at flowering with a mean of 30.43 cm while ICCV 95334 (Kabuli type) were the shortest plants at flowering with a mean of 26.76 cm. Findings show that Desi type cultivars produced taller plants at flowering than Kabuli type chickpea.

The observed differences among the chickpea varieties further indicated their differential adaptability to local conditions as well as their inherent height potential. Furthermore, Desi varieties are taller naturally than Kabuli type varieties.

Effect of row orientation. There were significant differences noted on the average plant height at flowering of chickpea as affected by the different row orientation used. Chickpea planted in a northeast to southwest row orientation produced the tallest plants at flowering with an average of 30.35 cm while chickpea planted in a north to south row orientation produced the shortest plants with an average of 26.3cm.

Interaction effect. Statistical analysis revealed significant differences on the average plant height at flowering of chickpea as affected by the interaction between the different row orientation used and the different chickpea varieties grown. Results revealed that ICCV 93954 (Desi type) planted in a northwest to southeast row orientation produced the tallest plants with a mean of 32.9 cm while ICCV 95334 (Kabuli type) planted in a north to south row orientation produced the shortest plants at 26.3 cm at flowering.



Table 3. Average plant height at flowering of two varieties planted in different row orientation

TREATMENT	Average plant height at flowering (cm)
<u>Variety (A)</u>	
ICCV 95334 “Kabuli type”	26.56 ^b
ICCV 93954 “Desi type”	30.43 ^a
<u>Row Orientation (B)</u>	
East to West Direction	28.14 ^{ab}
North to South Direction	26.3 ^b
Northeast to Southwest Direction	30.35 ^a
Northwest to Southeast Direction	29.59 ^{ab}
A x B	Significant
CV (%)	11.87

Means with a common letter are not significantly different at 5% DMRT

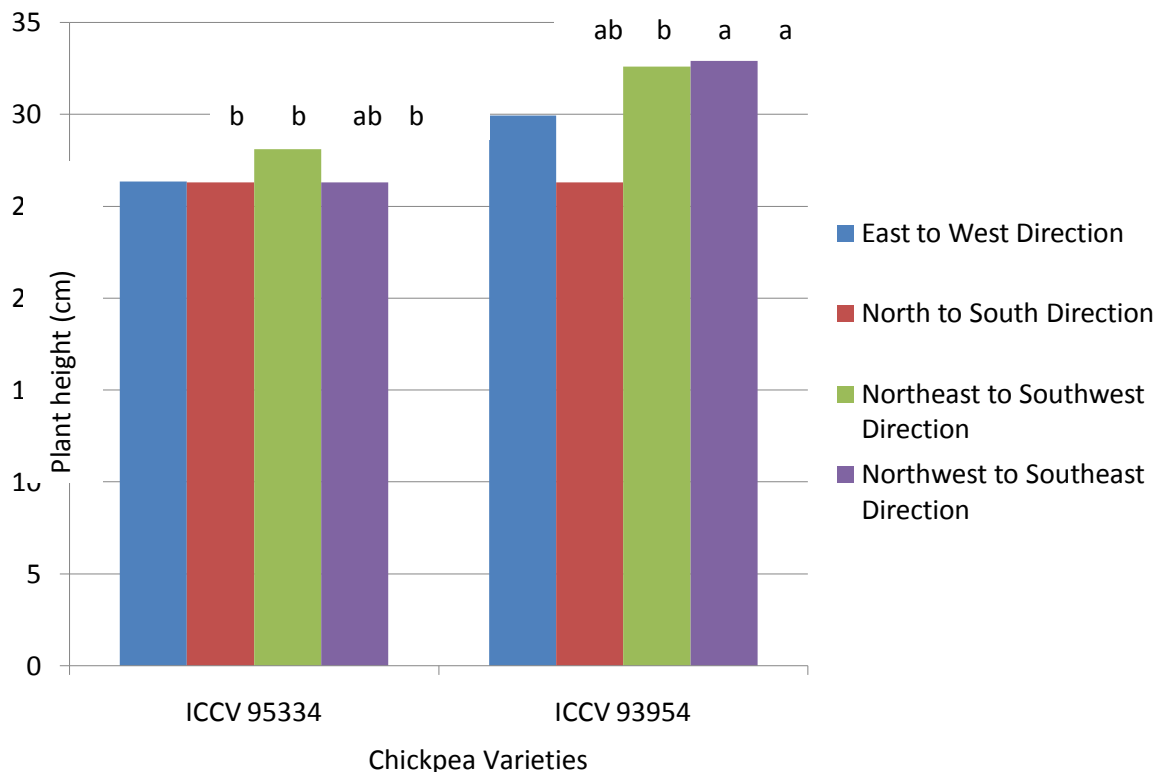


Figure 10. Average plant height at flowering



Average Number of Pods per Plant

Effect of variety. The average number of pods per plant of chickpea as presented in Table 4 showed highly significant differences among the different varieties of chickpea grown. Results showed that ICCV 93954 (Desi type) produced the highest number of pods produced per plant with an average of 44.95 pods while ICCV 95334 (Kabuli type) produced the least number of pods per plant with an average of 21.93 pods. Findings show that Desi type varieties produced higher number of pods per plant than Kabuli type chickpea variety.

Effect of row orientation. There were significant differences noted on the average number of pods per plant as affected by different row orientation used. Results show that chickpea planted in a northwest to southeast row orientation produced the most number of pods per plant with an average of 44 pods while chickpea planted in a north to south row orientation produced the least number of pods per plant with an average of 21.75 pods.

Interaction effect. Statistical analysis revealed that there were no significant differences obtained on the average number of pods per plant of chickpea as affected by the interaction between the different row orientation and different chickpea varieties used. Average number of pods per plant ranged from 21.75 to 44 pods per plant. Results show that the different row orientations did not significantly affected the average number of pods per plant.



Table 4. Average number of pods per plant of two varieties planted in different row orientation

TREATMENT	Average number of pods per plant
<u>Variety (A)</u>	
ICCV 95334 “Kabuli type”	21.93 ^b
ICCV 93954 “Desi type”	44.95 ^a
<u>Row Orientation (B)</u>	
East to West Direction	31.57 ^{ab}
North to South Direction	21.75 ^b
Northeast to Southwest Direction	35.93 ^{ab}
Northwest to Southeast Direction	44 ^{ab}
A x B	Not significant
CV (%)	13.82

Means with a common letter are not significantly different at 5% DMRT

Weight of Marketable Seeds (g)

Effect of variety. Table 5 shows that there were no significant differences noted on the weight of marketable seeds of chickpea as affected by the different varieties evaluated. However, numerical data indicated that ICCV 93954 (Desi type) produced the heaviest weight of marketable seeds while ICCV 95334 (Kabuli type) produced the least weight of marketable seeds.

Effect of row orientation. Likewise, there were no significant differences noted in the weight of marketable seeds as affected by the different row orientation used. Numerically, chickpea planted in a northwest to southeast row orientation produced the heaviest weight of marketable seeds while the chickpea planted in a north to south row orientation produced the least weight of marketable seeds.



Table 5. Weight of marketable seeds (g) of two varieties planted in different row orientation

TREATMENT	Weight of marketable seeds (g)
<u>Variety (A)</u>	
ICCV 95334 “Kabuli type”	98.40 ^a
ICCV 93954 “Desi type”	161.44 ^a
<u>Row Orientation (B)</u>	
East to West Direction	103.59 ^a
North to South Direction	95.42 ^a
Northeast to Southwest Direction	155.37 ^a
Northwest to Southeast Direction	165.32 ^a
A x B	Not significant
CV (%)	12.32

Means with a common letter are not significantly different at 5% DMRT

We

Interaction effect. There were no significant differences in the weight of marketable seeds as affected by the interaction between the different row orientation and different chickpea varieties grown.

Weight of Non-marketable Seeds (g)

Effect of variety. There were no significant differences noted in the weight of non marketable seeds as affected by different chickpea varieties grown. Weight of non-marketable seeds ranged from 22.45 to 31.17 grams.

Effect of row orientation. Significant differences were noted on the weight of non-marketable seeds as affected by the different row orientations used. Chickpea planted in a northwest to southeast row orientation produced the heaviest weight of non-



marketable seeds with a mean of 38.73 g while chickpea planted in a north to south row orientation produced the least weight of non-marketable seeds with a mean of 14.77 g.

Table 6. Weight of non-marketable seeds (g) of two varieties planted in different row orientation

TREATMENT	Weight of non-marketable seeds (g)
<u>Variety (A)</u>	
ICCV 95334 “Kabuli type”	31.17 ^a
ICCV 93954 “Desi type”	22.45 ^a
<u>Row Orientation (B)</u>	
East to West Direction	25.47 ^b
North to South Direction	14.77 ^b
<u>Total</u> Northeast to Southwest Direction	28.27 ^b
Northwest to Southeast Direction	38.73 ^a
A x B	Not significant
CV (%)	22.75

Means with a common letter are not significantly different at 5% DMRT

Interaction effect. There were no significant differences noted in the weight of non-marketable as affected by the interaction effect between the different row orientation and different row orientation and different variety of chickpea used.

Total Yield per Plot (g)

Effect of variety. There were no significant differences noted on the total yield per plot as affected by the different variety of chickpea used. However, results in table 7 show that ICCV 93954 (Desi type) attained the highest yield per plot with a mean of 188.62 g while ICCV 95334 (Kabuli type) had attained the lowest yield per plot with a mean of 128.37 g.



Effect of row orientation. There were no significant differences noted on the total yield per plot as affected by the different row orientation used. Results however, show that chickpea planted in a northwest to southeast row orientation attained the highest

Table 7. Total yield per plot (g) of two varieties planted in different row orientation

TREATMENT	Total yield per plot (g)
<u>Variety (A)</u>	
ICCV 95334 “Kabuli type”	128.37 ^a
ICCV 93954 “Desi type”	188.62 ^a
<u>Row Orientation (B)</u>	
East to West Direction	129.12 ^a
North to South Direction	110.18 ^a
Northeast to Southwest Direction	183.63 ^a
Northwest to Southeast Direction	211.07 ^a
A x B	Not significant
CV (%)	12.32

Means with a common letter are not significantly different at 5% DMRT

yield per plot with a mean 211.07 g while chickpea planted in a north to south row orientation attained the lowest yield with a mean of 110.18 g.

Interaction effect. There were no significant differences noted in the total yield per plot as affected by the interaction effect between the different row orientation and different variety of chickpea used.

Computed Yield (t/ha)

Effect of variety. There were no significant differences noted on the computed yield per hectare as affected by the different variety of chickpea used. However, results showed that ICCV 93954 (Desi type) produced the highest computed yield per hectare with a mean



of 5.91 tons while ICCV (Kabuli type) produced the lowest computed yield per hectare with a mean of 4.024 tons (Table 8).

Table 8. Computed yield (t/ha) of two varieties of chickpea planted in different row orientation

TREATMENT	Computed yield (t/ha)
<u>Variety (A)</u>	
ICCV 95334 “Kabuli type”	4.024 ^a
ICCV 93954 “Desi type”	5.91 ^a
<u>Row Orientation (B)</u>	
East to West Direction	4.05 ^a
North to South Direction	3.45 ^a
Northeast to Southwest Direction	5.75 ^a
Northwest to Southeast Direction	6.60 ^a
A x B	Not significant
CV (%)	14.27

Means with a common letter are not significantly different at 5% DMRT

Effect of row orientation. There were no significant differences noted on the computed yield per hectare as affected by the different row orientation used. However, results showed that chickpea planted in a northwest to southeast row orientation produced the highest computed yield per hectare with a mean of 6.60 tons while chickpea planted in a north to south row orientation produced the lowest computed yield per hectare with a mean of 3.45 tons.

Interaction effect. Analysis revealed no significant differences on the computed yield per hectare as affected by the interaction between the different variety and the different row orientation used.



Biomass Weight (g)

Effect of variety. There were highly significant differences noted on the biomass weight of chickpea as affected by the different varieties grown. Results show that

Table 9. Biomass weight (g) of two varieties planted in different row orientation

TREATMENT	Biomass Weight (g)
<u>Variety (A)</u>	
ICCV 95334 “Kabuli type”	1962.5 ^b
ICCV 93954 “Desi type”	3011.3 ^a
<u>Row Orientation (B)</u>	
East to West Direction	1787.5 ^b
North to South Direction	1637.5 ^b
Northeast to Southwest Direction	3660 ^a
Northwest to Southeast Direction	2862.5 ^{ab}
A x B	Significant
CV (%)	9.55

Means with a common letter are not significantly different at 5% DMRT

ICCV 93954 (Desi type) produced the heaviest biomass weight with a mean of 3011.3 g while ICCV 95334 (Kabuli type) produced the least biomass weight with a mean of 1962.5 g.

Effect of row orientation. Likewise, significant differences were noted on the biomass weight as affected by the different row orientation used. Results showed that chickpea planted in a northeast to southwest row orientation produced the heaviest biomass weight with a mean of 3660 g while chickpea planted in a north to south row orientation produced least biomass weight with a mean of 1637.5 g.

Interaction effect. Statistical analysis revealed significant differences in the biomass weight of chickpea as affected by the interaction between row orientation and



different varieties used. Results showed that ICCV 93954 (Desi type) planted in a northeast to southwest row orientation produced the heaviest biomass with a mean of

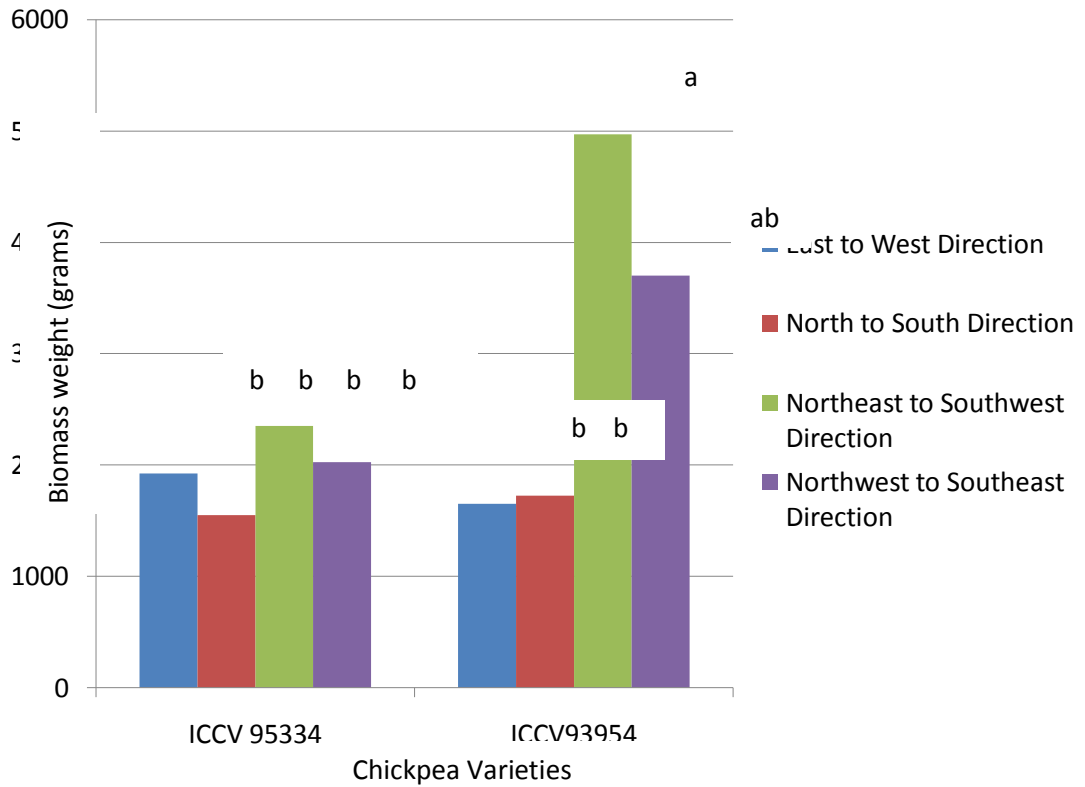


Figure 11. Biomass weight

4970 g; while ICCV 95334 (Kabuli type) planted in a north to south row orientation produced the least biomass weight with a mean of 1550 g.

Harvest Index

Effect of variety. There were no significant differences noted on the harvest index of chickpea as affected by the different varieties grown. Results in Table 10 showed that the harvest index of chickpea ranged from 7.03 to 12.05.



Effect of row orientation. Likewise, there were no significant differences noted on the harvest index of chickpea as affected by the different row orientation used. However, chickpea plants planted in northwest to southeast direction obtained the highest harvest

Table 10. Harvest index of two varieties of chickpea planted in different row orientation

TREATMENT	Harvest Index
<u>Variety (A)</u>	
ICCV 95334 “Kabuli type”	1962.5 ^b
ICCV 93954 “Desi type”	3011.3 ^a
<u>Row Orientation (B)</u>	
East to West Direction	1787.5 ^b
North to South Direction	1637.5 ^b
Northeast to Southwest Direction	3660 ^a
Northwest to Southeast Direction	2862.5 ^{ab}
A x B	Significant
CV (%)	9.55

Means with a common letter are not significantly different at 5% DMRT

index while chickpea plant planted in northeast to southwest direction had the least value of harvest index.

Interaction effect. Analysis revealed that there were no significant differences in the harvest index of chickpea as affected by the interaction between the different row orientation and the different variety used.

Weight of 100 Seeds

Effect of variety. There were significant differences noted in the weight of 100 seeds of chickpea as affected by different variety of chickpea used. Results showed that ICCV 95334 (Kabuli type) produced the heaviest weight of 100 seeds with a mean of 35.05



g; while ICCV 93954 (Desi type) produced the least weight of 100 seeds of chickpea with a mean of 18.69 g. Kabuli type of chickpea had generally bigger sized seeds of chickpea that lead to heavier 100 seed weight (Table 11 and Figure 12).

Table 11. Weight of 100 seeds (g) of two varieties of chickpea planted in different row orientation

TREATMENT	Weight of 100 seeds (g)
<u>Variety (A)</u>	
ICCV 95334 “Kabuli type”	35.05 ^a
ICCV 93954 “Desi type”	18.69 ^b
<u>Row Orientation (B)</u>	
East to West Direction	27.28 ^a
North to South Direction	26.86 ^{ab}
Northeast to Southwest Direction	24.99 ^b
Northwest to Southeast Direction	28.37 ^a
A x B	Significant
CV (%)	7.24

Means with a common letter are not significantly different at 5% DMRT

Effect of row orientation. There were significant differences noted on the weight of 100 seeds affected by the different row orientation used. Results showed that chickpea planted in a northwest to southeast row orientation produced the heaviest weight of 100 seeds of chickpea with a mean of 28.37g while chickpea planted in a northeast to southwest row orientation produced the least weight of 100 seeds of chickpea with a mean of 24.99g.

Interaction effect. Statistical analysis revealed significant differences on the weight of 100 seeds of chickpea as affected by the interaction between the different row orientation and the different variety of chickpea used. Results showed that ICCV 95334



(Kabuli type) planted in a northwest to southeast row orientation produced the heaviest weight of 100 seeds of chickpea with a mean of 37.55 g while ICCV 93954 (Desi type)

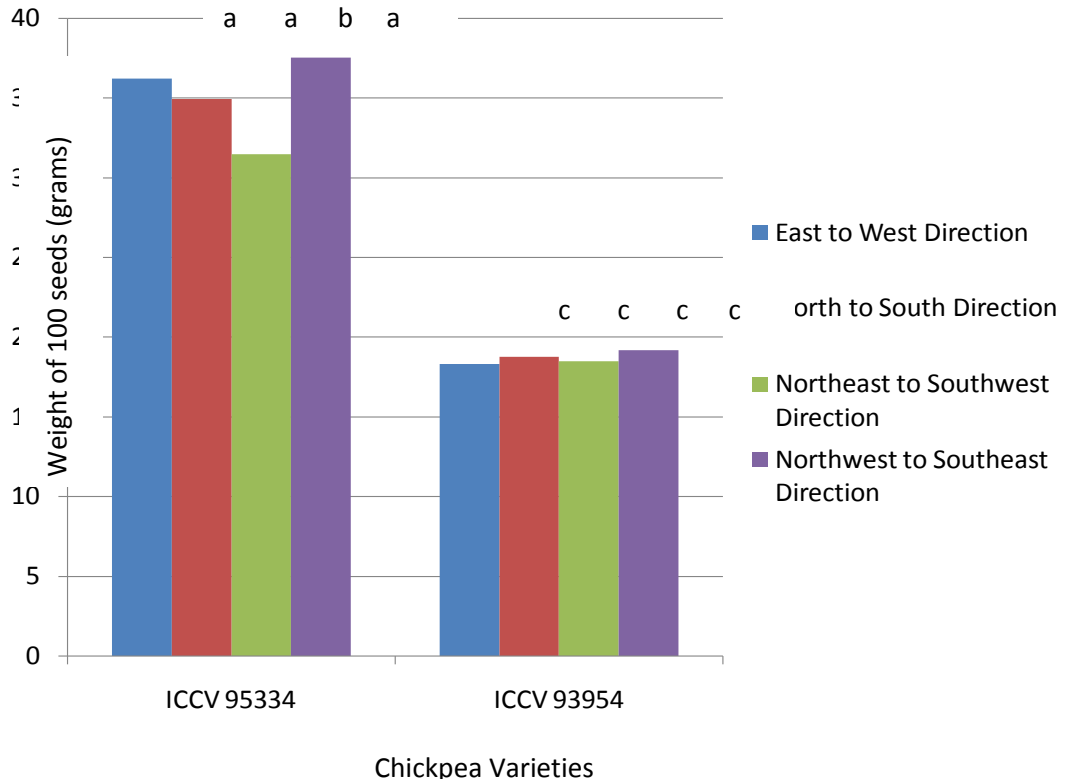


Figure 12. Weight of 100 seeds

planted in a east to west row orientation produced the least weight of 100 seeds of chickpea with a mean of 18.33g.



SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted to determine the yield of chickpea varieties grown as intercrops in between citrus trees, to determine the effect of different row orientation on the yield of chickpea and to determine the effect of row orientation on the growth and yield of chickpea for seed production. The study was conducted at the Benguet State University, Horticulture Laboratory Area, La Trinidad, Benguet from November 2012 to March 2013.

Result show that there were no significant differences noted on the effect of row orientations on the number of days from planting to 50% flowering.

Chickpea plant grown on east to west row orientation were the earliest to mature after 142 days while chickpea planted on a northeast to southwest row orientation was the latest after 155.5 days.

Chickpea plants grown in a northeast to southwest row orientation produced the tallest plants with an average of 30.35 cm, produced the highest number of pods per plant with an average of 44 pods and produced the heaviest biomass weight with a mean of 3011.3 g while chickpea planted in a north to south row orientation produced the shortest plants with an average of 26.3 cm, produced the lowest number of pods with an average of 21.75 pods and produced the least biomass weight with a mean of 1637.5 g.

There were no significant differences noted on the weight of marketable seeds, the weight of non-marketable seeds.

Results also showed no significant differences on the total yield per plot, harvest index and computed yield per hectare, with regards to the effect of varieties, different row orientation and interaction effect.



In the weight of 100 seeds, results showed that chickpea planted in a northwest to southeast direction produced the heaviest weight of collected 100 seeds with a mean of 28.37 g while chickpea planted in a northeast to southwest direction produced the least weight of collected 100 seeds with a mean of 24.99 g.

Results showed that ICCV 95334 (Kabuli type) were the earliest to reach 50% flowering, the earliest to mature, produced the shortest plants at flowering, produced the least number of pods, produced the least biomass weight and produced the heaviest weight of 100 seeds, while ICCV 93954 (Desi type) were the latest to reach 50% flowering, the latest to mature, produced the highest number of pods, produced the heaviest biomass weight of chickpea and produced the lightest weight of 100 seeds.

ICCV 93954 (Kabuli type) chickpea plants grown in a northwest to southeast row orientation flowered earlier after 48.25 days from planting and produced the heaviest weight of 100 seeds of chickpea with a mean of 37.55 g.

ICCV 95334 (Desi type) chickpea plants grown in a northeast to southwest row orientation had more days to bear flower at 67 days, produced the heaviest biomass weight with a mean of 4970 g and produced the least weight of 100 seeds of chickpea with a mean of 18.33 g.

ICCV 95334 (Desi type) chickpea plants grown in a northwest to southeast row orientation were the latest to mature after 160 days from planting and produced the tallest plants at flowering with an average of 32.9 cm.

ICCV 93954 (Kabuli type) chickpea plants grown in a north to south direction produced the shortest plants with an average of 26.3 cm at flowering and produced the least biomass weight with a mean of 1530 g.



Result show that ICCV 93954 (Kabuli type) chickpea plants grown in east to west row orientation matured earlier after a mean of 135 days from planting.

Conclusion

Based on the results discussed, the best variety under La Trinidad, Benguet condition is ICCV 93954, a Desi type of chickpea since it had a good growth, flowering and yield characteristics when grown in the best row orientation for the selected variety is the northeast to southwest direction of row orientation.

Recommendation

Based on the Findings and conclusion of the study, ICCV 93954, a Desi type of chickpea can be productively grown in a northeast to southwest row orientation and is therefore recommended under La Trinidad, Benguet condition when grown under citrus trees.



LITERATURE CITED

- ANONYMOUS. 2007, Chickpea. Wikipedia, The Free Encyclopedia. Retrieved July 28, 2007 from. <http://www.google.com.ph>.
- BALAD, T.T. 1980. Effect of plot orientation and plot size on growth and yield of garden pea. Undergraduate Thesis. MSAC, La Trinidad, Benguet Province.
- CHAPMAN, S. R. and L. P. CARTER. 1976. Effects of light on the production of cotton. Crop Production, principles and practice. Pp. 159-153:386.
- CORTEZ, L. C. 1978. Effects of distance of planting on the growth and yield of head of Lettuce. Undergraduate thesis (Unpub.) MSAC, La Trinidad, Benguet Province.
- CRANDAL, L. G. 1971. Effects of rows and direction and mist on micro climate of Bush Bean. Horticulture Science 6:345-347.
- EVANGELIO, M. D. 1979. Influence of variety, spacing and fertilizer on the stem and production of potatoes. VISCA VISTA, Vol. 2:12-13.
- KRIEDMAN, W.M. 1970. Leaf age photosynthesis in *Vitis venifera* L. Vitis 9:97-104.
- OEBKER, Y. L., HOPEN, E. N. 1974. Field diagnosis of Chickpea diseases and their control. Information Bulletin no. 28. Pantacheru, Andhra Pradesh 502.324, India. International Crops Research Institute for the Semi-arid tropics.
- POLON, N. F. 1981. Influence of plot orientation on the growth and yield of snap bean. Undergraduate thesis (Unpub.) MSAC, La Trinidad, Benguet.

