BIBLIOGRAPHY

TELCAG, BRENDA E. MAY 2011. Growth and Yield of Asparagus (*Asparagus officinalis* L.) As Affected by Planting Distance under La Trinidad Benguet condition. Benguet State University, La Trinidad Benguet.

Adviser: Fernando B. Gonzales, PhD.

ABSTRACT

The study was conducted at Horticulture thesis area, Benguet State University, La Trinidad Benguet. From November 2010 to April 2011 to determine the growth and yield of asparagus as affected by planting distance, and to determine the planting distance that would produce the optimum five months after transplanting.

Result of the study showed that plants spaced at 50cm x 40 cm had higher number of marketable spears per plant and resulting to heavier yield per plot (1m x 3) of 254.30g followed by plants distanced at 50cm x 50cm (204.97g) in two month harvesting period.

Asparagus plant planted at 50cm x 40cm and 50cm x 50cm between hills and rows out yielded the other treatments including the farmers practice in terms of marketable spears.

INTRODUCTION

Asparagus officinalis L. is a flowering plant species in the genus Asparagus from where the vegetable known as asparagus spears is obtained. It is native to most of Europe, Northern Africa and Western Asia and is now widely cultivated as a vegetable crop.

Asparagus is a herbaceous perennial plant growing up to 99.6-149.80 cm tall with short lateral stems and with much branched feathery foliage. The leaves are in fact needle like modified stems in the axils of scales leaves; they are 6-32 cm, (0.5-3 cm) long a 1mm (0.39 ins.) broad and clustered 4-15 leave together. Its roots are tuberous. The flower are bell shaped, greenish-white to yellow, 4.5-6.5 mm. (0.4-0-9 cm) long, with six partially fused together at the base. They are produced singly or in cluster of 5-7.5 cm. the junctions of the small branches. It is usually dioecious with male and female flowers on separate plants but sometimes hermaphrodite flowers are found. The fruit is small red berry 6-1 diameter. The plants are native to Western Coast of Europe from Northern Spain to Ireland, Great Britain and Norwest Germany ate treated as vegetable. *Asparagus officinalis subsp.* (Dumort) Corb is distinguished by its low growing, often prostate stem growing to only 30-70 cm high, shorter modified stems 2-18 mm (0,079-0.71 cm) long. It is treated as distinct species. Asparagus offinalis L. Has been used from the early times as a vegetable crop and medicine crop owing to its delicate flower and diuretic properties. It was cultivated ancient Egyptians, Greeks, and Romans, who ate it fresh when it is season and dried the vegetable for use in winter. Only the young shoots as Asparagus are eaten. Asparagus is low in Calories, contains no cholesterol and is very low in sodium. It is good source of folic acid, potassium dietary fiber and lutien. The amino acid aspergines get its

name from Asparagus, the Asparagus plant being rich in this compound. The shoots are prepared and served in a number of ways around the world (Hartman and Kester, 1995).

The study was conducted to determine: 1) the effect of plant spacing on the growth and yield of Asparagus; and to ascertain the best plant spacing for asparagus for production under La Trinidad, Benguet condition.

The study was conducted at the Horticulture thesis area from November 2010-April 2011.

REVIEW OF LITERATURE

Botany of Asparagus

Asparagus is a herbaceous perennial plant 50-150cm tall. The stem is erect smooth with many branches; branches always form a sharp angle with the stem. Lateral twigs are flattened and substitute for the leaves. The axils branch is thin, straight, filiform phyllocladia, 1-3 cm in length, set in bundles, 3-6 cm each. The plant is dioecious. Flowers are settled in the axils of lateral twigs. Male flowers are half in the size. Its fruit is a berry or brick-red color, 8 mm in diameter. Blossoms beginning in mid June. Berries ripen gradually. The plant is usually cross- pollinated; pollen is transported by insects, mainly Bess; but wind pollination is possible (Geirenko and Shilova, 1988).

Growth Habit

Asparagus prefers sunny conditions and a loose, well drained soil. It tolerates heavier clay soils as long as the soil has good drainage and the water table does not come within four feet of the surface, which would interfere with the plants extensive and deep root system. The ideal pH range for asparagus is between 6.7 and 7.5. It does not tolerate acid soil and will not grow well at pH of less than 6.0. A soil pH maintained at 7.0 or above will reduce the effects of fusarium crown and root rot, a fungal disease that contributes to asparagus decline. Asparagus dies not decline with a lot of water once it has become established, and it tolerates brackish water and moderately saline conditions. The garden site may be in vegetable plot or along fence or wall, where the fern like foliage will form an attractive low screen (Paul, 1999).

Crop Culture

Asparagus seed are usually sown in a sterilized soil mixture containing ½ sterilized soil, ¼ peat sand, or a commercially peat-lite “The Cornell mix (1/2 peat, ½ vermiculate) works well for asparagus seeds. The planting depth of asparagus seeds is critical. Seeds are sown one per cell, placing it to ½ to 5/8 cm below the top of the soil to keep the seed pushing itself out. The crowns should be planted at least 30-45 cm apart, in single rows, with distance the rows. Two rows would be fine in a bed 1-1.5 m wide (Precheur, 1998).

Nutritional Value

Its stalks are high in antioxidants. Asparagus provides essential nutrients; six spears contain 135 micrograms of foliate. Almost half the adult RDI) Recommended Daily Intake), 545 micrograms of beta carotene, and 20 milligrams of potassium 9 (Readers Digest, 1992). Research suggests foliate as the key in taming homocystine, a substance implicated in heart disease. Foliate is also good for pregnant mothers, since it protects against neutral tube defects in babies. Several studies indicate that getting plenty of potassium may reduce the loose of calcium from the body. Particularly green asparagus is a good source of Vitamin C. six times more than those found in citrus fruits, Vitamin C helps the body produce and maintain collagen. Considered a wonder protein, collagen helps hold together all the cells and tissues of the body. Asparagus has been recognized for its medicinal properties (Onstad, 1994), author of: Whole Food Companion: Asparagus; A guide for adventurous cooks, curious shoppers and lovers of natural foods: Asparagus is a high value crop and of the earliest to produce spring vegetable. In Asian-style cooking, asparagus spears are stir-fried with chicken, shrimps or beef it can be wrapped in bays sauce, melted butter or olive oil, parmesan cheese or mayonnaise.

Asparagus may also used as an ingredient in some a stews and soup. In the French style, it is often boiled or steamed and served with hollandaise source, melted butter or olive oil, parmesan cheese or mayonnaise. It may even be used in deserts.

Plant Spacing

Spacing is one of the cultural requirements in crop productivity. It is practical way of preventing plants from competing with each other in absorption or nutrient, water and in the utilization of light for plant growth. In addition, proper spacing prevents the plant from rooting competition. Likewise, high yield and normal growth can be attained if he proper cultural management practices like appropriate planting distance are observed. It determines plant population in a given area, thus it is also determinant in yield.

The wide between –row spacing is needed because the fern growth of the hybrid verities is vigorous am\and will usually frill the between-row space after one growing season if one year old crowns are planted. It also allow for better air circulation to promote faster fern drying from rain and morning dews. This delayed the onset of foliar fungus diseases.

The idea spacing and plant population are those that maximize yield and quality without unduly increasing production cost (Anon., 1990). As a role all crops tended to have increased yield with wider spacing, but up to certain limit. He also added that beyond this limit, the yield may not increase further and may even drop.

Bautista and Mabesa (1975) stated that as plant population per unit area increase the yield per unit will also increase until the spacing is also close enough that excessive competition between adjacent plants reduces the yield per plant, further, the distance between row and with rows varies with each grower's situation. Wider spacing is needed

where plant requirement for moisture and nutrients cannot be met at a closer spacing where growing large vegetable is desirable and where the variety requires such spacing.

Burton (1996) added that if spacing is close, the individual plant will suffer from the competition of its neighbors and the growth of the crop may be impaired. But he also contradicted that if spacing is too wide; the yield per hectare may also less despite the increases in yields of individual plants.

In 1979, Wiley stated that population density refers to the number of plants per unit which determines the space available for its use. Janick (1972) also said that the yield area which determines to a large extent that efficiency of land utilization. Population pressure offer competition by decreasing the size.

In 1972, Watts added that the proper distance between plants depends upon the variety, purpose of the crop, fertility of the soil, methods of cultivation, spraying and harvesting.

MATERIALS AND METHODS

The materials used were: 3 months old asparagus seedling, garden tools, record book, vernier caliper and measuring tools.

Experimental Design and Treatments. Treatment plots were laid out following the Randomized Complete Block Design (RCBC) with 10 treatments replicated three times. The treatments were as follows:

Code	Planting Distance (cm) (Row x Hill)	Plant Population ($3m^2$)
T_0	35 x 35	17
T_1	30 x 30	20
T_2	30 x 40	15
T_3	30 x 50	12
T_4	40 x 30	20
T_5	40 x 40	15
T_6	40 x 50	12
T_7	50 x 30	20
T_8	50 x40	15
T_9	50 x 50	12

Care and Maintenance

The recommended cultural practices were done uniformly to all asparagus plants throughout the duration of the study.

Irrigation

Watering was done after transplanting the seedlings through the use of watering can followed by three times a week irrigation.

Weed Control

Weeds was done by uproot weeds to prevent competition between plant sand weeds in terms of space, sunlight and nutrients.

Plant Preparation

An area of 100m^2 was prepared and was divided into three blocks where each block was subdivided into 3 plots to represent the treatments. Plot size was measures 1X3m2 per treatments combination. Where it was basally applied with a hand half a sagana 100 and 75g of 14-14-14 fertilizer per hill. Hilling-up operation was done one month from transplanting.

Data Gathered

1. Plant height at harvest (cm). Plant height of five sample plants was measured using foot rule at the time of first harvest.

2. Days from transplanting to first harvesting of spears (0.5 cm in diameter). This was done by counting the number of days from transplanting to first harvesting of spear.

3. Number of spears produced per plant after five months from transplanting. This was done by counting the number of spears harvested per plant after five months from transplanting of seedlings.

4. Length of spears (cm). This was taken during harvesting.

5. Average spear diameter produced per plant will be taken in five months. This was taken for five months by measuring all the diameter of the spears produced by sample plants divided by the number of sample plants .

6. Average weight of spears. This was be done by obtaining the average weight of harvestable spears.

7. Number and weight of marketable spears. This was done by obtaining the weight of the spears produced per plant after five months from transplanting.

8. Yield per plot. This was done by obtaining the weight produced per plot five months from transplanting.

9. Number and weight of non-marketable yield per plot. This was done by obtaining the weight of crocked spears produced per plot for five months duration.

10. Photo Documentation. This was done through pictures (Figure 1 to 4).

11. Meteorological data (temperature (^{0}C) humidity (%) day length (hrs.) and rainfall (mm). This was taken from BSU PAG-ASA for the duration of the study.

Figure 1. Overview of the study 3 months from transplanting.

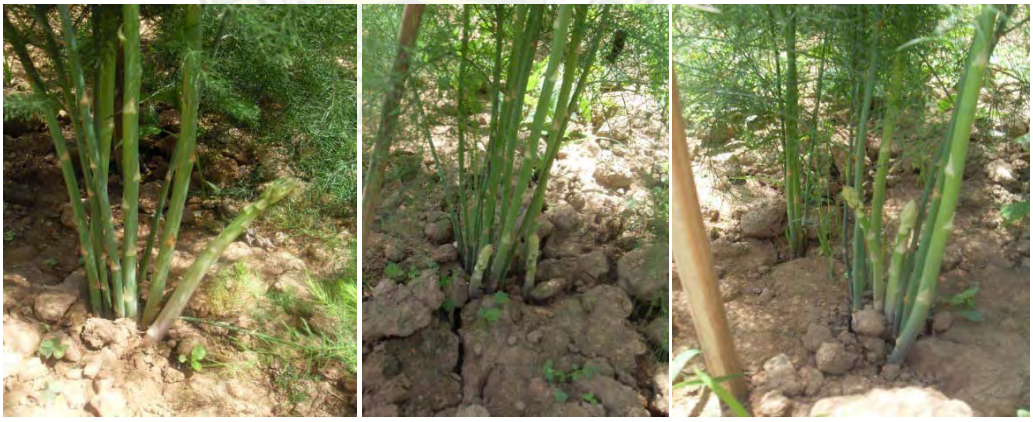

Figure 2. Close up appearance of spears at harvest.

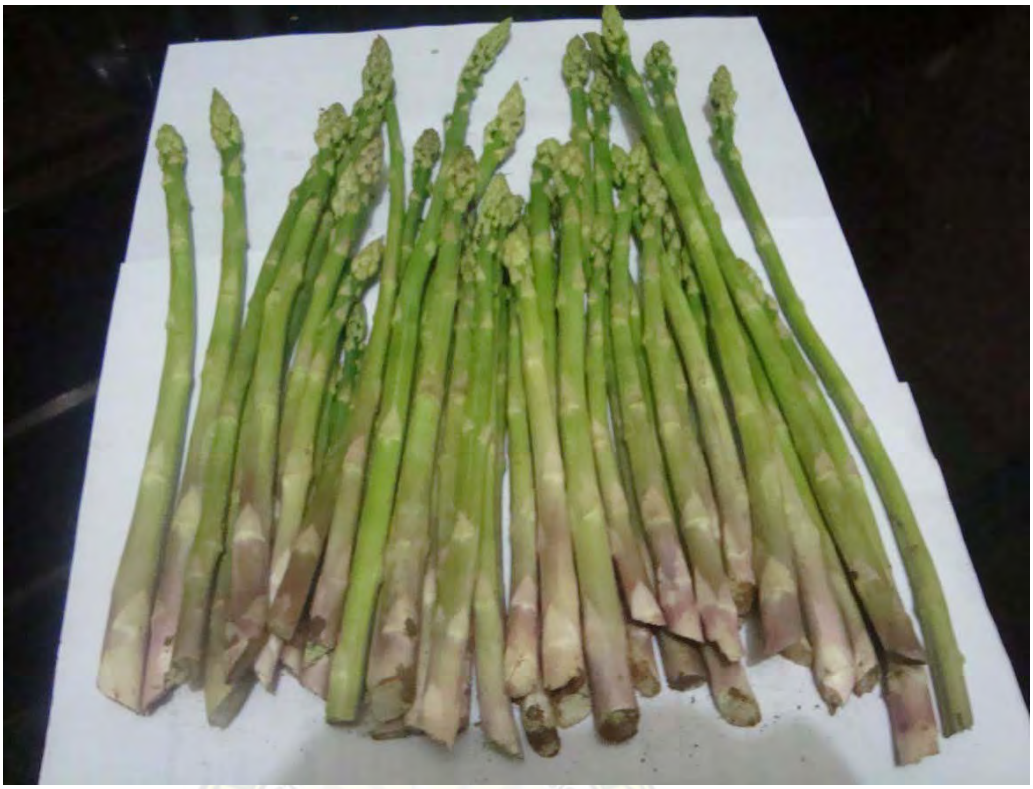

Figure 3. Marketable spears

Figure 4. Non- marketable spears

RESULTS AND DISCUSSION

Plant Height at Harvest

Table 1 show that there were no significant differences obtained on the plant height at harvest of asparagus plants as affected by planting distance. Nevertheless, the plant weights at harvest ranged from 29.10 cm. to 35.07 cm. Results further show that plant height at harvest was not affected by the early plant stages when plant canopy was not yet fully developed.

Days from Transplanting to Harvesting of Spears

Table 2 shows that planting distance has no significant effect on the members of days from transplanting to harvest. Spears from plants spaced closer (farmer practice of

Table 1. Plant height at harvest

TREATMENT	MEAN (cm)
35 x 35 cm (Farmers Practice)	30.63[a]
30 x 30 cm	29.10[a]
30 x 40 cm	30.23[a]
30 x 50 cm	34.95[a]
40 x 30 cm	31.70[a]
40 x 40 cm	33.69[a]
40 x 50 cm	34.85[a]
50 x 30 cm	29.53[a]
50 x 40 cm	35.07[a]
50 x 50 cm	35.41[a]

Means with the same letter are not significantly different at 0.05 levels of significant by DMRT

Table 2. Days from transplanting to harvesting of spears

TREATMENT	MEAN (Days)
35 x 35 cm (Farmers Practice)	117.33[a]
30 x 30 cm	119.93[a]
30 x 40 cm	117.60[a]
30 x 50 cm	119.53[a]
40 x 30 cm	119.33[a]
40 x 40 cm	119.40[a]
40 x 50 cm	118.87[a]
50 x 30 cm	117.60[a]
50 x 40 cm	119.20[a]
50 x 50 cm	181.87[a]

Means with the same letter are not significantly different at 0.05 level of significance by DMRT

35 cm x 35 cm), however were harvested earlier while wider spacing tended to delay later harvesting date.

Number of Spears Produced Per Plant
After Five Months From Transplanting

Plants spaced at 50 x 40 cm and 50 x 50 cm produced significantly more number of spears five months from transplanting over the plants spaced at 30 x 30 cm as shown in Table 3. Results show that closer spacing will result in plant shading and nutrient competition that leads to shading of the spears produced; while wider spacing had more number of spears produced five months from transplanting due to the absence of shading between plants.

Table 3. Number of spears produced per plant after 5 months from transplanting

TREATMENT	MEAN
35 x 35 (Farmers Practice)	4.00[abc]
30 x 30 cm	3.53[c]
30 x 40 cm	3.67[bc]
30 x 50 cm	3.87[abc]
40 x 30 cm	4.20[ab]
40 x 40 cm	4.20[ab]
40 x 50 cm	4.07[abc]
50 x 30 cm	4.20[ab]
50 x 40 cm	4.33[a]
50 x 50 cm	4.33[a]

Means with the same letter are not significantly different at 0.05 level of significance by DMRT

As stated by Burton (1996), if spacing is closer, the individual plants will suffer from the competition of its neighbors and the growth of the crop may be impaired. Moreover, Ahlawat and Sarat (1994) wrote that the inter plant competition for light is greater at higher densities resulting in more natural shading which in turn increase cell elongation thus, increasing plant height.

Length of Spears (cm)

As presented in Table 4, length of spears at harvest showed no significant differences observed among the various spacing treatments evaluated. Nevertheless, plant spaced at 50 x 50 cm produced the longest spear with a mean of 10.24 cm and the

Table 4. Length of spears at harvest

TREATMENT	MEAN (cm)
35 x 35 (Farmers Practice)	7.76[a]
30 x 30 cm	7.51[a]
30 x 40 cm	7.49[a]
30 x 50 cm	7.79[a]
40 x 30 cm	8.13[a]
40 x 40 cm	9.59[a]
40 x 50 cm	7.96[a]
50 x 30 cm	8.50[a]
50 x 40 cm	10.24[a]
50 x 50 cm	8.85[a]

Means with the same letter are not significantly different at 0.05 level of significance by DMRT

shortest spear was from plants spaced at 30 x 30 cm with a mean of 7.51 cm. Nonetheless, the other spacing treatments produced comparable lengths of spears at harvest.

Average Spear Diameter

As presented in Table 5, the increasing distance of planting correspondingly increased the diameter of asparagus spears. However, statistical analysis shows that there were no significant differences observed among the different treatments means. These results do not differ with the report of Diachanco (1959) that planting distance of root crops varies according to the desired size of roots to be produced; and in cases where smaller roots are preferred, the planting distance must be closer. He further mentioned

Table 5. Average spear diameter per plant

TREATMENT	MEAN(cm)
35 x 35 (Farmers Practice)	0.62[a]
30 x 30 cm	0.63[a]
30 x 40 cm	0.61[a]
30 x 50 cm	0.68 [a]
40 x 30 cm	0.67[a]
40 x 40 cm	0.67[a]
40 x 50 cm	0.68[a]
50 x 30 cm	0.67[a]
50 x 40 cm	0.69[a]
50 x 50 cm	0.74[a]

Means with the same letter are not significantly different at 0.05 levels of significant by DMRT

that spacing affects the root formation, thus the size of roots attained at maturity should serve as a guide to an effective planting distance.

Average Weight of Spears

Table 6 shows the average weight of spears at 0.5cm diameter. As presented, plant spaced at 50 x 50 cm produced spears that significantly out-weighted the spears produced from plants spaced at 40 x 50 cm and 50 x 30 cm that had similar weight of individual spears produced. The heavier weight of spears from the planting distance 50 x 40 cm. may

Table 6. Average weight of spears at 0.5 diameter

TREATMENT	MEAN (g)
35 x 35 cm (Farmers Practice)	34.37[bc]
30 x 30 cm	35.62[bc]
30 x 40 cm	25.49[c]
30 x 50 cm	30.56[bc]
40 x 30 cm	30.93[bc]
40 x 40 cm	37.50[abc]
40 x 50 cm	33.64[bc]
50 x 30 cm	38.53[abc]
50 x 40 cm	49.09[a]
50 x 50 cm	42.34[ab]

Means with the same letter are not significantly different at 0.05 level of significance by DMRT

may be due to the longer and thicker spears produced from plants with wider spacing.

Number of Marketable Spears Produced per Plant Five Months From Transplanting

Statistical analysis showed significant differences in the number of marketable spears produces per plant five months from transplanting as affected by the different planting distances as presented in Table 7. Asparagus plants spaced at 50 x 40 cm has the highest number of marketable spears per plant while plants spaced at 30 x 30 cm and 30 x 40 cm had comparable lower number of marketable spears per plant. The higher number of marketable spears obtained from plants spaced at 50 x 40 cm and 50 x 50 cm maybe due to observations that during the first harvesting these was lesser number of spears

Table 7. Number of marketable spears produced per plant 5 months from transplanting

TREATMENT	MEAN
35 x 35 (Farmers Practice)	4.75^{bcde}
30 x 30 cm	3.53^{e}
30 x 40 cm	3.87^{e}
30 x 50 cm	4.20^{de}
40 x 30 cm	4.80^{dcde}
40 x 40 cm	5.80^{abc}
40 x 50 cm	4.53^{cde}
50 x 30 cm	5.93^{ab}
50 x 40 cm	4.75^{bcde}
50 x 50 cm	5.30^{abcd}

Means with the same letter are not significantly different at 0.05 level of significance by DMRT

harvested. During the second to the third harvests however, there more spears produced per plant, and was correspondingly increased in the succeeding harvesting of spears.

Weight of Marketable Spears.

Table 8 shows the average weight of marketable spears produced per plant five months from transplanting as influenced by the various plant spacing evaluated. It was observed that as the distance of planting increased, the number of spears produced also increased resulting to greater weight per plant. Asparagus spaced at 50 x 40 cm

Table 8. Weight of marketable spears per plant 5 months from transplanting

TREATMENT	MEAN (g)
35 x 35 (Farmers Practice)	33.86^{bcd}
30 x 30cm	21.73^{d}
30 x 40cm	25.25^{cd}
30 x 50cm	28.15^{bcd}
40 x 30cm	31.67^{bcd}
40 x 40cm	39.13^{abc}
40 x 50cm	31.54^{bcd}
50 x 30cm	40.35^{ab}
50 x 40cm	50.86^{a}
50x 50 cm	40.97^{ab}

Means with the same letter are not significantly different at 0.05 level of significance by DMRT

significantly produced heavier marketable spears which was higher over those planted with other planting distances. It was followed by those plants spaced at 50x50cm but was statistically comparable with plants spaced at 30 x 30 cm between hills and rows.

The results imply that in the asparagus plants, the weight of marketable spears correspondingly increased, as the planting spacing between plants was increased

Total Yield per Plot Five Months from Transplanting

Table 9 shows significant differences on the total yield per plot of asparagus as affected by the different planting distance. Plant with a 50 x 40 cm planting distance produced the heaviest weight of roots produced per plot with a mean of 254.30 g as compared to the plants spaced at 30 x 30 cm which yielded the lowest yield having a mean

of 17.57g. Results further showed that yield per plot was significantly higher when plants were spaced at 50 x 40 cm. due to more number of plants per area compared to 50 x 50 cm. spacing.

As cited by Bautista and Mabesa (1975) that as plant population per unit area increases, the yield per unit will also increase until the spacing is close enough that excessive competition between adjacent plants reduces the yield per plants. Further, the distances between rows and with in rows varies with each growers situation. Wider spacing is needed where plant requirements for moisture and nutrients cannot be met at a closer spacing where growing large vegetable is desirable and where the variety requires such spacing.

Table 9. Weight of marketable spears produced per plot 5 months from transplanting

TREATMENT	MEAN (g)
35 x35 cm (Farmers Practice)	150.70^{bcd}
30 x 30 cm	108.57^{d}
30 x 40 cm	117.57^{cd}
30 x 50 cm	140.77^{bcd}
40 x 30 cm	158.33^{bcd}
40 x 40 cm	195. 63^{abc}
40 x 50 cm	157.70^{bcd}
50 x 30 cm	202.63^{ab}
50 x 40 cm	254.30^{a}
50 x 50 cm	204.97^{ab}

Means with the same letter are not significantly different at 0.05 level of significance by DMRT

Number of Non Marketable Spears per Plant

Table 10 shows no significant differences on the number of non marketable spears produced per plant. However, the mean number of non marketable spears ranged from 3.223 to 4.30.

Weight of Non- Marketable Spears Per Plant

There were no significant effects of the different planting distances on the weight of non-marketable spears per plant (Table 11). Nevertheless, the mean non-marketable spear range from 9.20 to 17.51 g per plant.

Table 10. Number of non-marketable spears per plant

TREATMENT	MEAN
35 x 35 cm (Farmers Practice	4.08[a]
30 x 30 cm	4.23[a]
30 x 40 cm	3.60[a]
30 x 50 cm	3.70[a]
40 x 30 cm	4.30[a]
40 x 40 cm	3.47[a]
40 x 50 cm	3.50[a]
50 x 30 cm	4.07[a]
50 x 40 cm	3.33[a]
50 x 50 cm	3.23[a]

Means with the same letter are not significantly different at 0.05 level of significance by DMRT

The plant canopy five months from transplanting was not yet fully developed where shading had not yet affected the developing spears that leads to insignificant number of non-marketable spears at harvesting.

Non-Marketable Spears Produced Per Plot

Table 12 shows the yield per plot of non-marketable spears. Statistical analysis showed significant differences observed among the various planting distance treatments evaluated.

Table 11. Weight of non- marketable spears per plant

TREATMENT	MEAN (g)
35 x35 cm (Farmers Practice)	17.51[a]
30 x 30 cm	16.11[a]
30 x 40 cm	13.35[a]
30 x 50 cm	15.71[a]
40 x 30 cm	15.51[a]
40 x 40 cm	10.45[a]
40 x 50 cm	14.29[a]
50 x 30 cm	13.53[a]
50 x 40 cm	9.20[a]
50 x 50 cm	9.73[a]

Means with the same letter are not significantly different at 0.05 level of significance by DMRT

Table 12. Yield per Plot of Non-Marketable Spears

TREATMENT	MEAN (g)
35 x 35 (Farmers Practice)	80.83[a]
30 x 30 cm	81.20[a]
30 x 40 cm	64.17[ab]
30 x 50 cm	60.40[ab]
40 x 30 cm	59.47[ab]
40 x 40 cm	61.63[ab]
40 x 50 cm	75.43[a]
50 x 30 cm	60.93[ab]
50 x 40 cm	34.13[c]
50 x 50 cm	46.93[bc]

Means with the same letter are not significantly different at 0.05 level of significance by DMRT

Meteorological Data

Table 13 presents the meteorological data obtained from Benguet State University PAG-ASA, Balili, La Trinidad, Benguet from October 2010 to January 2011.

Maximum and temperatures; were obtained during the month of October, while the coolest temperature were obtained during the month of January. Relative humidity was highest during the month of October, but decreased during the month of November to

December and little bit increased during the month of January. Relative humidity was high during the month of December; while month of October had the longest day length.

Table 13. Meteorological data

MONTH	RH (%)	RAINFALL (mm.)	TEMPERATURE Min.	Max.	DAY LENGTH (Hours)
Oct. (2010)	87.0	30.3	25.2	15.4	721.2
Nov. (2010)	86.0	6.3	24.8	15.2	698.3
Dec. (2010)	92.0	3.6	25.1	13.6	686.7
Jan. (2011)	85.3	11.5	24.3	13.0	686.7

SUMMARY, CONCLUSION AND RECOMENDATION

Summary

The study was conducted at Department of Horticulture thesis research Benguet State University, La Trinidad Benguet. From November 2010 to April 2011 to determine the growth and yield of asparagus as affected by planting distance, and to determine the optimum planting distance in Asparagus production under La Trinidad, Benguet condition.

Results of the study showed that plants spaced at 50 x 40 cm had higher number of marketable spears per plant resulting to heavier yield per plot (1m x 3m) of 254.30g followed by plants grown at a distance of 50 cm x 50 cm with 204.97g; five months from transplanting. The 30 cm x 30 cm distance affected had the lowest yield of spears with only 108.57g per plot.

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Conclusion

Based on the results, it can be concluded that 50 cm x 40 cm spacing is the best asparagus production since it was observed that it promoted the production have more number of spears per plant five months after transplanting of seedlings.

Recommendation

It is then recommended that a 50 cm x 40 cm planting distance should be used in asparagus production under La Trinidad, Benguet Condition. This planting distance promoted the production of more marketable spears resulting to higher yield per plot. It is also recommended that the study showed be continued to record the yield for longer harvesting durations since asparagus is a perennial plant.

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APPENDICES

Appendix Table 1. Plant height at harvest (cm)

TREATMENT	BLOCK I	II	III	TOTAL	MEAN
T0	27.40	32.10	32.40	91.90	30.63
T1	33.10	25.96	28.24	87.30	29.10
T2	30.10	31.00	29.60	90.70	30.23
T3	35.78	35.24	34.70	104.84	34.95
T4	34.90	33.48	30.12	95.10	31.70
T5	31.50	35.78	28.40	101.06	33.69
T6	33.44	39.40	31.70	104.54	34.85
T7	26.84	35.90	25.84	88.58	29.53
T8	30.30	40.86	34.06	105.22	35.07
T9	38.10	32.33	35.80	106.23	35.41

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SS	MS	COMPUTED F	TABULAR F 0.05	0.01
Block	2	249.65221	24.8261			
Treatment	9	172.9555	19.21727	1.645031^{ns}	2.4563	3.5971
Error	18	210.2763	11.68201			
TOTAL	29	432.8839				

^{ns}- Not significant Coefficient of variation 10.51%

Appendix Table 2. Days from transplanting to harvesting of spears

TREATMENT	BLOCK I	II	III	TOTAL	MEAN
T0	116.00	117.60	118.40	352.00	117.33
T1	120.00	119.40	120.40	359.80	119.93
T2	116.00	118.40	118.40	352.80	117.60
T3	119.40	119.20	120.00	358.60	119.53
T4	121.20	118.40	118.40	358.00	119.33
T5	119.20	121.40	117.60	358.20	19.410
T6	118.60	120.40	117.60	356.60	118.87
T7	117.60	117.60	117.60	352.80	117.60
T8	119.20	119.20	119.20	357.60	119.20
T9	119.60	120.20	116.80	356.60	118.87

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SS	MS	COMPUTED F	TABULAR F 0.05	0.01
Block	2	2.850667	1.425333			
Treatment	9	22.96667	2.551852	1.64345^{ns}	2.4563	3.5971
Error	18	27.94933	1.552741			
TOTAL	29	53.76667				

^{ns}- Not significant Coefficient of variation 1.05%

Appendix Table 3. Number of spears produced per plant after five months from transplanting

TREATMENT	BLOCK I	BLOCK II	BLOCK III	TOTAL	MEAN
T0	3.80	3.80	4.40	12.00	4.00
T1	3.40	3.60	3.60	10.60	3.53
T2	3.80	3.60	3.60	11.00	3.67
T3	3.80	4.00	3.80	11.60	3.87
T4	3.80	4.60	4.20	12.60	4.20
T5	4.60	3.80	4.20	12.60	4.20
T6	4.60	3.80	3.80	12.20	4.07
T7	3.80	4.40	4.40	12.60	4.20
T8	4.40	4.20	4.40	13.00	4.33
T9	4.20	4.40	4.40	13.00	4.33

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SS	MS	COMPUTED F	TABULAR F 0.05	TABULAR F 0.01
Block	2	0.024	0.012			
Treatment	9	2.032	0.225778	2.454106*	2.4563	3.5971
Error	18	1.656	0.092			
TOTAL	29	3.712				

*- Significant Coefficient of variation 7.51%

Appendix Table 4. Length of spears (cm)

TREATMENT	BLOCK I	II	III	TOTAL	MEAN
T0	9.34	6.29	7.66	23.29	7.76
T1	8.43	8.80	5.29	22.52	7.51
T2	7.49	7.49	7.49	22.47	7.49
T3	7.99	6.66	8.79	23.36	7.79
T4	8.44	8.69	7.27	24.40	8.13
T5	10.82	7.89	10.05	28.76	9.59
T6	8.59	7.46	7.82	23.87	7.96
T7	8.23	8.49	8.79	25.51	8.50
T8	9.25	10.97	10.49	30.71	10.24
T9	8.99	8.87	8.70	26.56	8.85

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SS	MS	COMPUTED F	TABULAR F 0.05	0.01
Block	2	2.051387	1.025693			
Treatment	9	23.00902	2.556557	2.239188^{ns}	2.4563	3.5971
Error	18	20.55121	1.141734			
TOTAL	29	45.61162				

^{ns}- Not significant Coefficient of variation 12.75%

Appendix Table 5. Average spear diameter per plant (cm)

TREATMENT	BLOCK I	II	III	TOTAL	MEAN
T0	0.71	0 .50	0.65	1.86	0.62
T1	0.64	0.63	0.62	1.89	0.63
T2	0.58	0.58	0.68	1.84	0.61
T3	0.70	0.65	0.69	2.04	0.68
T4	0.61	0.70	0.70	2.01	0.67
T5	0.70	0.62	0.70	2.02	0.67
T6	0.69	0.63	0.72	2.04	0.68
T7	0.71	0.62	0.68	2.01	0.67
T8	0.68	0.70	0.68	2.06	0.69
T9	0.80	0.73	0.69	2.22	0.74

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SS	MS	COMPUTED F	TABULAR F 0.05	0.01
Block	2	0.013817	0.006903			
Treatment	9	0.037697	0.004189	1.778424^{ns}	2.4563	3.5971
Error	18	0.042393	0.002355			
TOTAL	29	0.093897				

^{ns}- Not significant Coefficient of variation 7.28%

Appendix Table 6. Average weight of spears at 0.5 diameter (cm)

TREATMENT	BLOCK I	II	III	TOTAL	MEAN
T0	33.62	34.15	35.33	103.10	34.37
T1	45.85	31.10	29.92	106.87	35.62
T2	26.20	23.76	26.52	76.48	25.49
T3	29 60	28.12	33.96	91.68	30.56
T4	24.76	36.34	31.70	92.80	30.93
T5	40.64	26.20	45.66	112.50	37.50
T6	46.56	27.52	26.84	100.92	33.64
T7	44.64	39.60	31.34	115.58	38.53
T8	42.08	57.64	47.56	147.28	49.09
T9	49.62	40.33	37.06	127.01	42.34

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SS	MS	COMPUTED F	TABULAR F 0.05	0.01
Block	2	97.57585	48.78792			
Treatment	9	1181.657	131.2952	2.605976*	2.4563	3.5971
Error	18	906.8822	50.38235			
TOTAL	29	2186.115				

*-Significant Coefficient of variation 19.82%

Appendix Table 7. Number of marketable spears produced per plant five months from transplanting

TREATMENT	BLOCK I	II	III	TOTAL	MEAN
T0	5.25	4.25	4.75	14.25	4.75
T1	3.80	3.60	3.20	10.60	3.53
T2	3.80	4.00	3.80	11.60	3.87
T3	3.80	4.00	4.80	12.60	4.20
T4	4.20	5.00	5.20	14.40	4.80
T5	6.80	4.20	6.40	17.40	5.80
T6	5.20	4.00	4.40	13.60	4.53
T7	5.60	7.00	5.20	17.80	5.93
T8	6.00	6.60	6.40	19.00	6.33
T9	6.20	4.50	4.20	25 90	5.30

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SS	MS	COMPUTED F	TABULAR F 0.05	0.01
Block	2	0.626	0.313			
Treatment	9	23.05342	2.561491	4.953818**	2.4563	3.5971
Error	18	9.307333	0.517074			
TOTAL	29	32.98675				

**-Highly significant Coefficient of variation 14.66%

Appendix Table 8. Weight of marketable spears per plant five months from transplanting (g)

TREATMENT	BLOCK I	II	III	TOTAL	MEAN
T0	42.53	22.75	36.30	101.58	33.86
T1	23.54	21.68	19.96	65.18	21.73
T2	26.05	23.88	25.82	75.75	25.25
T3	21.34	28.30	34.82	84.46	28.15
T4	25.22	37.18	32.60	95.00	31.67
T5	44.50	26.56	46.32	117.38	39 13
T6	37.10	29.38	28.14	94.62	31.54
T7	46.60	42.32	32.12	121.04	40.35
T8	44.58	59.96	48.04	152.58	50.86
T9	47.60	41.16	34.16	122.92	40.97

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SS	MS	COMPUTED F	TABULAR F 0.05	0.01
Block	2	37.60709	18.80354			
Treatment	9	2013.357	223.7063	4.20835**	2.4563	3.5971
Error	18	956.8389	53.15772			
TOTAL	29	3007.803				

**- Highly significant Coefficient of variation 21.23%

Appendix Table 9. Weight of marketable spears per plot five months from transplanting (g)

TREATMENT	BLOCK I	II	III	TOTAL	MEAN
T0	250.10	96.80	105.20	452.10	150.70
T1	117.50	108.40	99.80	325.70	108.57
T2	104.20	119.40	129.10	352.73	117.57
T3	106.70	141.50	174.10	422.30	140.77
T4	126.10	185.90	163.00	475.00	158.33
T5	222.50	132.80	231.60	586.90	195.63
T6	185.50	146.90	140.70	473.10	157.70
T7	233.00	211.60	163.30	607.90	202.63
T8	222.90	299.80	240.20	762.90	254.30
T9	238.30	205.80	170.80	614.90	204.97

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SS	MS	COMPUTED F	TABULAR F 0.05	0.01
Block	2	2054.021	1027.01			
Treatment	9	54243.44	6027.048	3.328618*	2.4563	3.5971
Error	18	32592.17	1810.676			
TOTAL	29	88889.62				

*- Significant Coefficient of variation 25.16%

Appendix Table 10. Number of non marketable spears per plant

TREATMENT	BLOCK I	II	III	TOTAL	MEAN
T0	4.25	4.50	3.50	12.25	4.08
T1	4.00	4.80	3.90	12.70	4.23
T2	3.20	3.60	4.00	10.80	3.60
T3	4.00	3.90	3.20	11.10	3.70
T4	3.80	4.60	4.50	12.90	4.30
T5	3.20	3.20	4.00	10.40	3.47
T6	3.40	3.40	3.70	10.50	3.50
T7	5.00	4.00	3.20	12.20	4.07
T8	3.80	2.20	4.00	10.00	3.33
T9	2.50	3.80	3.40	9.70	3.23

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SS	MS	COMPUTED F	TABULAR F 0.05	0.01
Block	2	0.038167	0.019083			
Treatment	9	4.067417	0.451935	1.159331^{ns}	2.4563	3.5971
Error	18	7.016833	0.389824			
TOTAL	29	11.12242				

^{ns}- Not significant Coefficient of variation 16.64%

Appendix Table 11. Weight of non- marketable spears per plant (g)

TREATMENT	BLOCK I	II	III	TOTAL	MEAN
T0	26.40	12.52	13.62	52.54	17.51
T1	13.08	18.10	17.14	48.32	16.11
T2	11.56	14.64	13.86	40.06	13.35
T3	26.40	10.30	10.43	47.13	15.71
T4	15.92	14.02	16.58	46.52	15.51
T5	12.18	9.94	9.24	31.36	10.45
T6	16.02	13.40	13.44	42.86	14.29
T7	17.88	8.72	13.98	40.58	13.53
T8	10.88	8.76	7.96	27.60	9.20
T9	10.66	9.64	8.88	29.18	9.73

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SS	MS	COMPUTED F	TABULAR F 0.05	0.01
Block	2	99.57381	49.7869			
Treatment	9	223.3469	24.81632	1.645821[ns]	2.4563	3.5971
Error	18	271.4109	15.07838			
TOTAL	29	594.3316				

[ns]- Not significant Coefficient of variation 28.68%

Appendix Table 12. Yield per plot of non-marketable spears (g)

TREATMENT	BLOCK I	II	III	TOTAL	MEAN
T0	115.10	80.00	47.40	242.50	80.83
T1	77.90	67.00	98.70	243.60	81.20
T2	58.10	74.40	60.00	192.50	64.17
T3	66.60	46.60	68.00	181.20	60.40
T4	64.60	54.60	59.20	178.40	59.47
T5	65 90	52.40	66.60	184.90	61.63
T6	76.30	84.70	65.30	226.30	75.43
T7	53.90	65.50	63.40	182.80	60.93
T8	39.30	33.50	29.60	102.40	34.13
T9	49.00	44.00	47.80	140.80	46.93

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SS	MS	COMPUTED F	TABULAR F 0.05	0.01
Block	2	259.7127	129.8563			
Treatment	9	5758.961	639.8846	3.288486*	2.4563	3.5971
Error	18	3502.501	194.5834			
TOTAL	29	9521.175				

*- Significant Coefficient of variation 22.31%