

Growth and Yield Performance of Multi- Stock Grafted Cashew

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ABSTRACT

This study was conducted to compare the performance of sexually and asexually propagated (*vis.* single stock, double stock and triple stock) cashew plants in terms of growth, age of trees at first fruiting, and yield.

Results showed that rapid growth of both sexually and asexually propagated plants in terms of height, girth and canopy size occurred on their 2nd – 4th year of field cultivation. Flowering of grafted seedlings was observed as early as 2 years, but their fruits was aborted after 3 weeks of development. Both sexually and asexually propagated plants bear fruits after 3 years.

In terms of yield, grafted cashew had significantly higher nuts and apple yield than those grown from seedlings. There is no significant difference however, on the yield in single, double, triple rootstock plants.

Keywords: cashew, Anacardium occidentale, multi-stock grafting asexual propagation

INTRODUCTION

Cashew (*Anacardium occidentale* Linn.) is widely known in the Philippines because of its vital economic importance. Traditionally, cashew are planted directly in the field through sexual propagation. Plants in most cases however, do not grow true-to-type when this kind of propagation is used. To minimize this effect, planting materials should be asexually propagated. Asexually propagation produces early bearing plants with desirable characteristics thereby producing good quality fruits.

At present, there are some practitioners planting grafted fruits trees like durian and mango in double or triple rootstocks. Among the possible benefits derived from this practice include high yields, more rapid growth of plants, increase resistance to drought, pests, diseases and resist breakage due to strong winds. It also reduces adverse effect of partial incompatibility between rootstocks and scion. Moreover, mortality in multiple rootstocks was found to be lesser than those of only single rootstock.

However, one disadvantage of multiple rootstocks is the need for more plants making the operation more expensive but the benefits derived appears to outweigh the additional cost (Pamplona and Garcia, ____).

This study was conducted determine the effect of multiple rootstocks grafting on the growth and yield of cashew. Specifically, it seeks to compare the effect sexually and asexually propagated cashew in terms of growth, age of trees at first fruiting, and yield.

METHODOLOGY

Nursery Operation

Sexual Propagation

Two hundred selected native cashew seeds were planted directly into the soil media contained in 14" x 18" plastic bag at a rate of one (1) seed per bag. Small amount of complete fertilizer was mixed with the soil media during potting. Two grams of Ammonium sulfate was applied per plant monthly until the seedlings were ready for grafting.

Watering and weeding of plants were done as frequently as necessary. Chemicals were sprayed on seedlings whenever there is an attack of pests and diseases.

Asexual Propagation

The single rootstock grafting using the cleft grafting method was performed prior to grafting double and triple seedstocks. This was carried out using seven-month old cashew seedlings. Cleft grafting was done by splitting the top of the rootstock to a height of 25 to 30 cm or where there is active growth. A wedge cut of 2-3 cm long was made on the basal end of the scion forming a tapering wedge. The wedged cut of the scion was then inserted into the rootstock. The stock-scion joint was firmly secured using grafting tape. The scion was then covered with plastic up to the point of union.

After five months, an additional one, and two rootstocks were attached to the single stock grafted plants (Fig. 1A) through modified inarching to produce the double-(Fig. 1B) and triple rootstocks plants (Fig.1C), respectively. Modified inarching was carried out by cutting the stem longitudinally about 2 cm long. A similar cut on the stem of scion was also made. Both cuts were then fitted together using plastic twine so that the cambiums of the stock and scion were held together. Four months after inarching or when the union between the stock and scion was established, the stocks were cut above the point of union. The wounds were treated with paint to avoid infection. The grafted seedlings were then transplanted to the field.

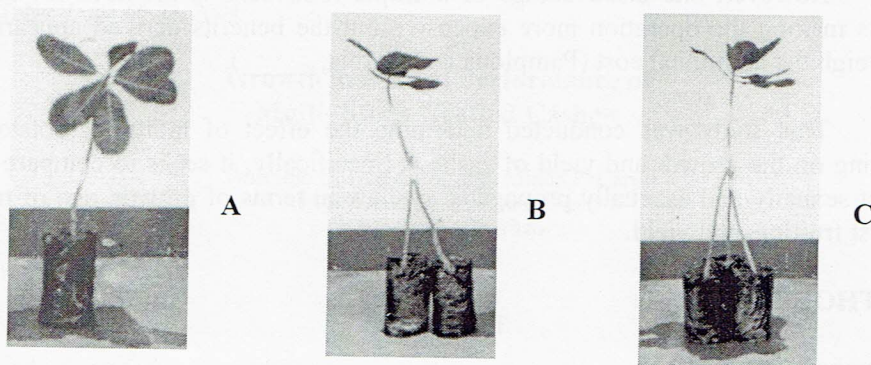


Figure 1. Asexually propagated cashew, (A) single rootstock, (B) double rootstock, and (C) triple rootstock.

Both sexually and asexually propagated seedlings were planted at a distance of seven (7) meters. Fifty (50) grams of urea was applied in each hole before planting.

Field Maintenance

Weed Control. The grasses in between the plants were cut regularly. The weeds around the base of the plants were also removed with the use of hoe and shovel as frequently as necessary.

Fertilization. The plants were cultivated and fertilized using the ring method of fertilizer application. Three kinds of fertilizer were mixed thoroughly and were applied to the individual plants as indicated below.

Table 1. Rate and time of fertilizer application.

Year	Fertilizer (grams)			Month
	N (45-0-0)	P (0-20-0)	K (0-0-60)	
1	50	-	-	October (planting)
2	100	-	-	October
3	175	350	530	October
4	255	510	760	October
5	255	510	760	October

Watering. Watering was done only during summer months in the first 2 years of field cultivation.

Control of Pests and Diseases. Spraying of cashew trees was done whenever there was an occurrence of pests and diseases.

RESULTS AND DISCUSSION

Growth

The asexually propagated seedlings grow faster in terms of height increment as compared to sexually propagated ones (Table 2). Results indicated that during the 1st and 2nd year of field cultivation, triple stock plants exhibited the highest mean height increment at 7.8 cm and 14.04 cm, respectively. On the 3rd and 4th year, the single stock plants grew faster with a mean height increment of 10.49 cm and 5.33 cm, respectively. There is a wide variation in height increment between treatment in the first three years of cultivation. The difference however is not statistically significant. This variation gradually declines until almost uniform growth can be observed. Generally, the growth of cashew in terms of height reaches its peak on the 2nd year of field cultivation (3 year old plants).

Table 2. Mean monthly increase in height (cm) of cashew trees per year

TREATMENT	1996-97	1997-98	1998-99	1999-00	2000-01	2002-02
T ₁ — seedling	5.50	9.53	5.43	4.05	2.57	2.58
T ₂ — single stock	3.80	12.85	10.49	5.33	2.55	2.98
T ₃ — double stock	4.00	11.62	9.79	4.99	2.84	2.38
T ₄ — triple stock	7.80	14.02	9.14	5.16	3.83	2.34

In terms of stem diameter, wide variation in mean monthly increase was observed between treatments with the asexually propagated plants showing the highest mean increase, though significant difference was observed only on the 4th year of cultivation (Table 3). Mean monthly increase in girth ranges only from 1.30 mm to 4.12 mm.

Table 3. Mean monthly increase in stem diameter (mm) of cashew trees per year.

TREATMENT	1996-97	1997-98	1998-99	1999-00	2000-01	2002-02
T ₁ — seedling	1.90	2.60	3.14	2.30 ^a	1.73	1.73
T ₂ — single stock	1.30	2.28	4.12	2.95 ^b	2.94	1.96
T ₃ — double stock	1.80	2.81	2.81	3.93 ^b	3.93	1.92
T ₄ — triple stock	2.90	3.43	3.43	3.76 ^b	3.76	2.31

Note: Means with letter superscripts are significantly different at 0.05 level.

The same growth trend was observed in terms of monthly increase in canopy diameter with asexually propagated plants exhibiting the highest mean increment in canopy diameter (Table 4). Highly significant difference was observed on the 3rd and 4th year of cultivation.

The highest mean monthly increase was observed on the 2nd year of cultivation with the triple rootstock plants showing the widest canopy diameter of 18.31 cm. As the plants mature, the mean canopy growth rate sharply declined to

5.61 cm (5th year). The same trend in canopy growth was observed among the single- and double rootstock plants.

The sexually propagated plants showed the least canopy growth increment at 14.75 cm (2nd year) to 3.75 cm (5th year). There was a slight increase on canopy growth on the 6th year in all treatments.

Table 4. Mean monthly increase in canopy diameter (cm) of cashew trees.

TREATMENT	1996-97	1997-98	1998-99	1999-00	2000-01	2002-02
T ₁ – seedling	-	14.75	8.91 ^a	4.93 ^a	3.75	3.76
T ₂ – single stock	-	16.52	15.38 ^b	11.92 ^b	5.09	5.05
T ₃ – double stock	-	16.46	14.14 ^b	10.88 ^b	3.79	5.14
T ₄ – triple stock	-	18.31	16.15 ^b	7.01 ^b	5.61	6.58

Note: Means with letter superscripts are significantly different at 0.01 level.

Age at First Fruiting

Grafted plants produced flowers as early as six months after planting in the field, but fruits were aborted after 3 weeks of development. The abortion of fruits might be due to the very young age of the plants. Eighteen months after field transplantation, both sexually and asexually propagated plants produced flowers and bear fruits.

Yield

The initial fruits produced by the cashew plants were heavier compared to those produced in the succeeding fruiting seasons (Table 5), this however is not statistically significant. The average weight of cashew apple ranged from 85.86 g to 96.30 g.

In terms of total yield per plant, significantly high yield was observed among double- and triple rootstock plants as compared to the single stock and sexually propagated plants (Table 6). There was a tremendous increase in apple production in the second harvest season. More than 400% increase in yield was observed in all treatments. Similar trend in apple production was observed in each harvest season wherein the sexually propagated plants consistently yielded the least.

Table 5. Mean weight (g) of cashew apple per harvest season.

TREATMENT	1999	2000	2001	2002
T ₁ – seedling	93.17	91.11	86.76	89.45
T ₂ – single stock	93.76	92.14	85.86	89.72
T ₃ – double stock	93.86	92.40	86.63	90.00
T ₄ – triple stock	96.30	90.71	90.58	87.91

Table 6. Average apple yield (kg) of cashew tree per harvest.

TREATMENT	1999	2000	2001	2002
T ₁ – seedling	2.14 ^b	12.66	16.53 ^b	23.10 ^b
T ₂ – single stock	2.65 ^b	12.81	17.22 ^b	29.83 ^a
T ₃ – double stock	3.23 ^a	13.42	20.87 ^a	28.98 ^a
T ₄ – triple stock	3.82 ^a	13.96	21.86 ^a	32.28 ^a

Note: Means with black letter superscripts are significantly different at 0.05 level. Those with blue letter superscripts are significantly different at 0.001 level.

There is no variation observed in average weight of individual nut per harvest season. Average nut weight ranged from 11.90 g to 13.61 g (Table 7). However, very low nut yield per tree was observed during the 1st harvest season. Cashew trees yielded only 0.296 kg to 0.539 kg nuts per tree. This can be attributed to the very young age of the plants, considering that the trees are only 3 years old. Furthermore, the plants were greatly affected by typhoon which coincided with its flushing period. This has significantly affected the cashew flower formation. Nut yield significantly increased to as much as 500% during the second harvest season.

Table 7. Average weight of seed (individual nut) per harvest season.

TREATMENT	1999	2000	2001	2002
T ₁ – seedling	12.87	11.90	12.16	11.93
T ₂ – single stock	12.52	12.99	12.06	13.17
T ₃ – double stock	13.17	13.29	12.61	13.61
T ₄ – triple stock	13.56	12.55	13.08	13.21

Significant difference in yield per tree was observed in all harvest season. Analysis indicated that cashew trees grown from seedlings has significantly lower yield than the asexually propagated ones (Table 8). Among the grafted cashew, triple rootstock plants had a slightly higher nut yield per tree compared to single- and double rootstock plants.

Table 8. Average nut yield (kg) of cashew trees/harvest season.

TREATMENT	1999	2000	2001	2002
T ₁ – seedling	0.296 ^b	1.63 ^b	2.30 ^b	3.30 ^b
T ₂ – single stock	0.364 ^a	1.81 ^b	2.39 ^b	4.36 ^a
T ₃ – double stock	0.461 ^a	1.93 ^a	3.00 ^a	4.39 ^a
T ₄ – triple stock	0.539 ^a	1.91 ^a	3.09 ^a	4.79 ^a

Note: Means with letter superscripts are significantly different at 0.05 level.

As expected mature plants yielded the highest volume of nuts as indicated in the production obtained during the 4th harvest season. This clearly demonstrates that as the cashew trees matures, the fruit production increases.

It can be concluded from the results that though the use of multiple rootstock grafting does not affect the growth rate and age at first fruiting of cashew plants, it however ensures high production in terms of nut and apple yield.

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