

Effects of irrigation , type of fertilizer and nitrogen rate on yield components and total yield of mango (*Mangifera indica* L.) in Abu Karshoula, South Kordofan State, Sudan

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ABSTRACT

An experiment was conducted at Abu Karshoula, South Kordofan State, Sudan, during the seasons of 2009/10 and 2010/11, to determine the effects of irrigation, type of fertilizer and nitrogen rate on yield components and total yield of the local mango cultivar Kitchener. Treatments consisted of irrigated or non-irrigated trees. Types of fertilizer were urea, cow manure and a combination of urea and cow manure. Nitrogen rates were 0 kg/ha, 43 kg/ha and 86 kg/ha. The treatments were arranged in a split-split plot design with irrigation treatments as the main plots, type of fertilizer as the sub-plots and N rates as the sub-sub plots, replicated three times. Results showed that irrigation of mango trees significantly increased exportable yield, cull yield, number of fruits per tree and total yield, whereas, withholding irrigation from mango trees gave higher locally marketable and lower cull yields in both seasons. Nitrogen fertilizer in the form of urea produced the largest number of fruits per tree and the highest locally marketable and total yields in both seasons. Combination of urea and cow manure significantly increased exportable yield in both seasons. However, nitrogen fertilizer in the form of cow manure alone gave the lowest total yield and number of fruits per tree in both seasons. Application of N at the rate of 86 kg/ha coupled with irrigation significantly increased number of fruits per tree, cull, exportable and total yields. Hence, it is recommended to irrigate mango trees and apply N in a combination of urea and cow manure at the rate of 86 kg/ha in order to increase total and exportable yields.

INTRODUCTION

Mango (*Mangifera indica* L.) cultivation is well established in South Kordofan State which is the leading State with respect to cultivated area (Ministry of Agriculture , South Kordofan State, 2009). Mango trees are not irrigated except at the early stages of orchard establishment. Fruiting mango trees depend only on rainfall which does not satisfy their water requirements all year round. Hence, low yields and poor fruit quality are not uncommon. Irrigation of mango trees is essential for high percentage of fruit set, reduction of fruit drop, and high yield (Larson *et al.*, 1989; Pongsomboon *et al.*, 1991; Simmons *et al.*, 1995) . Regular irrigation of mango trees was found to decrease fruit drop and produce large-sized fruits (Singh and Arora, 1965; Samson, 1989; Stephenson *et al.*, 1999).

Mango growers in South Kordofan State do not fertilize their orchards, probably because of their sheer ignorance about the benefits of irrigation to the mango trees or to cut down on the expenses of production. However, nitrogen fertilization is crucial for healthy tree growth and high yield of mango fruit crop (Crane and Campbell, 1991; Oothuyse, 1995). Similarly, Dass *et al.* (2004) reported that maximum yield and larger fruit size were produced by trees supplied with urea and manure as compared to unfertilized trees. Research work on mango irrigation and fertilization in South Kordofan State is lacking. Therefore, the objective of this study was to determine the effects of irrigation, type of fertilizer and N rate on yield components and total yield of the local mango cultivar, Kitchener.

MATERIALS AND METHODS

An experiment was conducted for two consecutive cropping seasons (2009/10 and 2010/11) at Abu karshoula, South Kordofan State, Sudan. The area is located at the intersection of latitude 9° N and 12° N and longitude 30° E and 48° E. The annual rainfall was 578 and 489 mm in the first and second seasons, respectively, distributed from May to October, and the soil is a cracking clay soil (Soil Conservation Department, Ministry of Agriculture, South Kordofan State, 2000). The orchards chosen for the experiment were planted with the mango cultivar Kitchener, which constitute more than 90% of the total cultivars in the State. The trees were nearly uniform in size, growth and bearing habits. The inter and intra – row spacing were 10m and 12m, respectively. The trees age ranged from 18-20 years. Kitchener cultivar is a mono-embryonic tree propagated from seed with a vigorous spreading canopy. The fruits are medium- sized, ovate in shape with a pulp of orange to yellow color, high fiber content and TSS and low acidity (Samson, 1989). Kitchener is an early cultivar which starts fruiting in November and extends till May.

Treatments

The treatments consisted of irrigation, fertilizer types and nitrogen rates. Two irrigation treatments were used; the trees were either irrigated or not irrigated. Irrigated trees were surrounded with embankments to harvest rain water during the rainy season. Supplementary irrigation was applied at the end of the rainy season at 10 days interval and continued till the fruits reached the full mature green stage. Non- irrigated orchards were not surrounded with embankments around the trees.

Nitrogen types were urea (46%N), cow manure (2.5%N) and 50% of each of urea and cow manure. Nitrogen was applied at the rates of 0 kg N/ha (control), 43 kg N/ha or 86 kg N/ha (Table 1).

Table 1. Type of fertilizer, nitrogen rate and corresponding amounts of fertilizers per hectare and per tree.

| Type of fertilizer | Nitrogen (kg/ha) | rate | Amount of fert. (kg/ha) | Amount of fert. (kg/tree) |
|--------------------|------------------|------|-------------------------|---------------------------|
| Control | | zero | zero | zero |
| U | | 43 | 94 | 0.95 |
| | | 86 | 188 | 1.9 |
| M | | 43 | 1720 | 17.2 |
| | | 86 | 3440 | 34.4 |
| C | | 43 | 47 U + 860 M | 0.475 U + 8.6 M |
| | | 86 | 94 U + 1720 M | 0.95 U + 17.2 M |

U, M and C = urea, cow manure and 50% combination of each, respectively.

Treatments were arranged in a split-split plot design with three replicates and two trees per plot. Irrigation treatments were the main plots, nitrogen types were the sub-plots and nitrogen rates were the sub-sub-plots. All fertilizer types and combinations were applied at the previously mentioned rates at the beginning of the rainy season in May, in one dose.

Leaf analysis

Leaf samples were taken before and after applying N fertilizers to determine nitrogen percentage (N %). The samples were taken randomly from each treatment, air-dried for 72 hours and ground using a mill. Nitrogen was determined using the micro-kjeldahl method.

Fruits were harvested at the mature green stage using picking poles in the morning and were kept in shade. Number of fruits per tree was counted immediately after harvesting and weighed. The fruits were sorted and those with blemishes, bruises, insect and mechanical damage (cull fruits) were weighed. The rest of fruits were weighed and fruits weighing more than 225 g were considered exportable. Locally marketable, exportable and total yields were determined.

Data were subjected to analysis of variance. Mean separation was done according to Duncan's Multiple Range Test (DMRT) at 5% level of significance.

RESULTS AND DISCUSSION

Effects of type of fertilizer, N rate and irrigation on leaf N content of mango trees

The highest leaf N content was found in trees which received urea or a combination of urea and cow manure at the higher N rate and coupled with irrigation. However, lack of irrigation, even with fertilization, resulted in significantly lower leaf N content (Table 2).

Table 2. Leaf nitrogen content of the local mango cultivar, Kitchener.

| Type of fertilizer | Nitrogen rate (kg/ha) | Irrigation | Leaf N content (%) | |
|---------------------|-----------------------|------------|----------------------|---------------------|
| | | | Before fertilization | After fertilization |
| Urea | 0 | + | 1.2 | 1.6 |
| | | - | 1.17 | 1.4 |
| | 43 | + | 1.11 | 1.92 |
| | | - | 1.31 | 1.8 |
| | 86 | + | 1.33 | 2.26 |
| | | - | 1.96 | 1.95 |
| Manure | 0 | + | 1.85 | 1.43 |
| | | - | 1.19 | 1.44 |
| | 43 | + | 0.67 | 1.79 |
| | | - | 1.31 | 1.18 |
| | 86 | + | 1.04 | 2.06 |
| | | - | 1.23 | 1.62 |
| Combination of both | 0 | + | 1.96 | 1.15 |
| | | - | 1.03 | 1.09 |
| | 43 | + | 1.42 | 1.84 |
| | | - | 1.11 | 1.64 |
| | 86 | + | 1.44 | 2.57 |
| | | - | 0.81 | 1.71 |

Effects of irrigation on yield components and total yield

The main effects of irrigation on yield components and total yield were significant in both seasons (Tables 3 and 4). Irrigation of mango trees resulted in a higher number of fruits per tree, cull, exportable and total yields in both seasons as compared to those of the non-irrigated control. However, irrigation resulted in lower locally marketable yield in both seasons, i.e. most of the fruits weighed > 225 g.

Irrigating mango trees during fruit developmental stages increased number of fruits per tree and total yield. This was due to the fact that irrigated trees had retained most of their initial fruit set as compared to non-irrigated ones which dropped most of their fruits at early stages of fruit development. These observations were in conformity with those of Singh and Arora (1965) who reported that irrigation increased yield from 60 to 136 fruits/harvest and decreased fruit drop from 590 to 197 fruits/tree. Simmons *et al.* (1995) also stated that irrigation prevented fruit drop and promoted the development of young fruits. Similarly, Pongsomboon *et al.* (1991) mentioned that irrigated trees had retained a larger percentage of their initial fruits compared with non-irrigated ones. Fulai *et al.* (2006) showed that irrigation improved tree productivity and reduced the phenomenon of alternate bearing.

Irrigation of trees also resulted in higher cull yield. This was because irrigated trees produced larger fruits which when they fell down during harvest were physically injured. However, withholding of irrigation from bearing trees reduced the occurrence of cull fruits because non-irrigated trees produced lighter, smaller-sized fruits which were not physically injured when they dropped to the ground during harvest. Also, irrigated trees produced higher exportable yield because irrigation resulted in large-sized fruits. However, non-irrigated trees produced higher locally marketable fruits. This was most probably due to the fact that water stress during fruit development resulted in small-sized fruits which were not

suitable for export. These results were in line with the findings of Singh and Arora (1989) who reported that trees which received no irrigation had the lowest fruit quality and the smallest size.

Table 3. Main effects of irrigation , type of fertilizer and N rate on yield components and total yield of the local mango cultivar, Kitchener (season 2009/10).

| Treatments | No. of fruits per tree | Cull yield (ton/ha) | Locally market. yield (ton/ha) | Exp. yield (ton/ha) | Total yield (ton/ha) |
|--------------------|------------------------|---------------------|--------------------------------|---------------------|----------------------|
| Irrigation | | | | | |
| + | 1198 | 3.05 | 2.28 | 15.5 | 20.83 |
| - | 1023 | 1.80 | 4.82 | 8.11 | 14.73 |
| Sig. level | * | ** | ** | ** | ** |
| Type of fertilizer | | | | | |
| U | 1138 ^a | 2.52 ^a | 4.24 ^a | 13.03 ^b | 20.82 ^a |
| M | 948 ^c | 2.46 ^a | 4.02 ^a | 10.18 ^c | 18.35 ^c |
| U+M | 1070 ^b | 2.02 ^a | 2.77 ^b | 14.43 ^a | 19.93 ^b |
| Sig. level | * | NS | * | * | * |
| N rate (kg/ha) | | | | | |
| 0 | 1095 ^b | 2.03 ^a | 3.94 ^a | 12.22 ^c | 18.19 ^c |
| 43 | 1140 ^a | 2.09 ^a | 2.75 ^{ab} | 15.60 ^b | 20.44 ^b |
| 86 | 1164 ^a | 2.10 ^a | 2.63 ^b | 16.62 ^a | 21.35 ^a |
| Sig. level | * | NS | * | * | * |

Means having the same letters in each sector of the same column were not significantly different according to Duncan's Multiple Range Test at 5% level.

*, ** and NS = significant at $P \leq 0.05$, 0.01 and not significant, respectively.

U, M and C = urea, manure and combination of both, respectively.

Table 4. Main effects of irrigation , type of fertilizer and N rate, on yield components and total yield of the local mango cultivar, Kitchener (season 2010/11).

| Treatments | No. of fruits per tree | Cull yield (tons/ha) | Locally market. yield (tons/ha) | Exp. yield (tons/ha) | Total yield (tons/ha) |
|---------------------------|------------------------|----------------------|---------------------------------|----------------------|-----------------------|
| Irrigation | | | | | |
| + | 978 | 2.34 | 2.20 | 14.22 | 18.76 |
| - | 531 | 0.57 | 3.37 | 5.28 | 9.22 |
| Sig. level | ** | * | * | * | * |
| Type of fertilizer | | | | | |
| U | 817 ^a | 2.63 ^a | 3.03 ^a | 7.64 ^b | 13.55 ^b |
| M | 669 ^b | 2.26 ^a | 2.61 ^b | 8.69 ^c | 14.47 ^a |
| U+M | 793 ^c | 2.35 ^a | 2.09 ^b | 9.03 ^a | * |
| Sig. level | ** | NS | * | * | |
| N rate (kg/ha) | | | | | |
| 0 | 732 ^b | 2.49 ^a | 5.53 ^a | 8.74 ^b | 13.83 ^c |
| 43 | 824 ^a | 2.55 ^a | 3.01 ^b | 9.49 ^{ab} | 16.60 ^a |
| 86 | 877 ^a | 2.67 ^a | 2.98 ^b | 11.52 ^a | * |
| Sig. level | ** | NS | * | * | |

Means having the same letters in each sector of the same column were not significantly different according to Duncan's Multiple Range Test at 5% level.

*, ** and NS = significant at $P \leq 0.05$, 0.01 and not significant, respectively.

U, M and C = urea, manure and combination of both, respectively.

Effects of type of fertilizer on yield components and total yield

Type of fertilizer had significant effects on number of fruits per tree, exportable, locally marketable and total yields in both seasons (Tables 3 and 4). Application of nitrogen in the form of urea resulted in the largest number of fruits per tree and the highest locally marketable and total yields. Combination of urea and cow manure resulted in the highest exportable yield in both seasons. Application of cow manure alone resulted in the lowest number of fruits per tree and total yield in both seasons. This indicated that the application of nitrogen in a combination of urea and cow manure produced larger exportable fruits. These results were consistent with the findings of Dass *et al.* (2004) who showed that maximum yields and fruit size were observed in trees supplied with a combination of manure and urea than that of the application of the recommended dose in the form of urea or manure alone. Although urea alone resulted in the highest total yield, yet it gave a large number of small fruits per tree which were not suitable for export and could only be locally marketed.

Effects of nitrogen rate on yield components and total yield

Nitrogen rate had significant effects on number of fruits per tree, exportable, locally marketable and total yields in both seasons (Tables 3 and 4). However, it had no significant effects on cull yield in both seasons. Nitrogen applied at 43 kg N/ha and 86 kg N/ha resulted in the largest number of fruits per tree

in both seasons, whereas, the control treatment resulted in the lowest. These results were in support of the findings of Scholefield *et al.*, (1984) who reported that nitrogen significantly increased the number of fruits per tree, fruit weight and yield as compared to unfertilized trees. The higher N rate (86 kg N/ha) resulted in the highest exportable and total yields and in the lowest locally marketable yield in both seasons (Tables 3 and 4). Since there were no significant differences in the number of fruits/tree between the two rates, this suggested that the higher N rate (86 kg/ha) resulted in an increase in fruit size. This was reflected in the significantly higher exportable yield and the lower locally marketable yield obtained by the higher N rate.

The interaction effects of type of fertilizer and irrigation were significant on all yield components (Table 5). Regardless of type of fertilizer, application of irrigation water resulted in significantly higher yield components and total yield. However, within each irrigation treatment, application of N in a combination of urea and cow manure gave the best results.

Table 5. Interaction effects of type of fertilizer and irrigation on yield components and total yield of the local mango cultivar, Kitchener (season 2010/11).

| Type of fertilizer | Irrigation | No. of Fruits per tree | Export. fruits (ton/ha) | Locally market. Fruits (ton/ha) | Cull fruits (ton/ha) | Total yield (ton/ha) |
|--------------------|------------|------------------------|-------------------------|---------------------------------|----------------------|----------------------|
| U | + | 1027 ^a | 13.702 ^{ab} | 3.742 ^a | 2.715 ^a | 20.395 ^a |
| | - | 573 ^c | 6.517 ^b | 3.978 ^a | 0.669 ^b | 9.405 ^b |
| M | + | 1096 ^a | 14.832 ^a | 2.304 ^b | 2.100 ^a | 18.691 ^{ab} |
| | - | 443 ^{cd} | 4.168 ^{bcd} | 3.304 ^a | 0.587 ^b | 7.497 ^{bcd} |
| C | + | 949 ^b | 14.264 ^a | 2.759 ^b | 2.654 ^a | 19.132 ^a |
| | - | 577 ^c | 5.213 ^{bc} | 3.214 ^a | 0.786 ^b | 8.303 ^{bc} |
| Sig. level | | * | * | * | * | * |

Means having the same letters in columns were not significantly different according to Duncan's Multiple Range Test at 5% level.

* = significant at $P \leq 0.05$.

U, M and C = urea, manure and combination of both, respectively.

+, - = irrigated and non-irrigated, respectively.

The interaction effects of N rate and irrigation on yield components and total yield were significant (Table 6). Irrespective of N rate, application of irrigation water resulted in significantly higher number of fruits per tree, exportable and total yields. Also, regardless of N rate, the number of fruits per tree and total yield produced by irrigated trees were double the values produced by non-irrigated trees. This suggested that non-irrigated trees did not benefit from the application of N fertilizers. This could be explained by the fact that irrigation water made N fertilizers soluble and the nutrients available in the soil solution in the root zone and ready for absorption by mango trees. In contrast, non-irrigated trees did not make use of applied N fertilization because most of it, especially urea, was lost by volatilization to ammonia and CO₂. Also, lack of irrigation prevented the hydrolysis and degradation of cow manure

into simple forms ready for absorption. These results are supported by leaf N content data (Table 2) which indicated that the highest values were obtained by the application of N in combination of urea and cow manure applied at the higher rate and accompanied with irrigation. Similarly, Ayoub (1984) reported that nitrogen losses from irrigated soil were only 8.2% compared to 42.2% in non-irrigated soil.

Table 6. Interaction effects of N rate and irrigation on yield components and total yield of the local mango cultivar, Kitchener (season 2010/11).

| Nitrogen rate (kg/ha) | Irrigation | No. of Fruits per tree | Exp. fruits (ton/ha) | Locally market. Fruits (ton/ha) | Cull fruits (ton/ha) | Total yield (ton/ha) |
|-----------------------|------------|------------------------|----------------------|---------------------------------|----------------------|----------------------|
| 0 | + | 939 ^{ab} | 12.95 ^{abc} | 1.74 ^d | 2.224 ^a | 15.26 ^c |
| | - | 524 ^c | 6.31 ^b | 2.74 ^b | 0.576 ^b | 8.65 ^d |
| 43 | + | 920 ^{ab} | 13.39 ^{ab} | 2.40 ^c | 2.212 ^a | 18.712 ^b |
| | - | 527 ^c | 5.47 ^b | 3.8 ^a | 0.489 ^b | 8.735 ^d |
| 86 | + | 1212 ^a | 14.14 ^a | 2.62 ^c | 2.591 ^a | 22.31 ^a |
| | - | 541 ^c | 5.88 ^b | 3.39 ^a | 0.633 ^b | 9.929 ^d |
| Sig. Level | | ** | * | * | * | * |

Means having the same letters in columns were not significantly different according to Duncan's Multiple Range Test at 5% level.

*, ** = significant at $P \leq 0.05$ and 0.01 , respectively.

+, - = irrigated and non-irrigated, respectively.

Irrigation of mango trees even without the application of N resulted in significantly higher exportable yield and lower locally marketable yield. This indicated that irrigation resulted in significantly larger fruits which satisfied the required standards of international markets. Along the same lines, application of N without irrigation, even at the higher rate of 86 kg/ha, did not result in a significant increase in the number of fruits per tree, exportable or total yields above those of the control treatment. These results suggested that application of N to mango trees without being coupled with irrigation is a futile exercise and a waste of money and labour. Irrigation of mango trees resulted in significantly higher cull fruit yield under all N rates. This was because irrigation produced larger-sized fruits which when harvested using the picking pole, fell to the ground and were physically injured due to their heavy weight. However, non-irrigated trees produced relatively small-sized and lighter fruits which were not physically injured during the harvest operation.

The three way interaction effects of type of fertilizer, N rate and irrigation were significant (Table 7). Regardless of type of fertilizer, application of N at the higher rate coupled with irrigation, resulted in the largest number of fruits per tree, exportable, cull and total yields and in the lowest locally marketable yield. Needless to say, lack of irrigation, regardless of type of fertilizer and rate, produced the lowest values of number of fruits per tree, exportable, total and cull yields and in the highest locally marketable yield.

In conclusion, application of N fertilizer to mango trees in the form of urea and cow manure at the rate of 86 kg N/ha coupled with irrigation resulted in the largest number of fruits per tree and the highest exportable and total yields in South Kordofan State.

Table 7. Interaction effects of type of fertilizer, N rate and irrigation on yield components and total yield of the local mango cultivar, Kitchener (season 2010/11).

| Type of fert. | N rate (kg N/ha) | Irr. | No. of fruits per tree | Export yield (ton/ha) | Locally market. yield (ton/ha) | Cull fruits (ton/ha) | Total yield (ton/ha) |
|---------------|------------------|------|------------------------|-----------------------|--------------------------------|----------------------|-----------------------|
| U | 0 | + | 960 ^{abcd} | 10.9 ^{abcd} | 1.9 ^{bcde} | 2.3 ^{abcd} | 15.1 ^{abcde} |
| | | - | 533 ^{cd} | 6.2 ^{cd} | 2.2 ^{bcd} | 0.5 ^e | 8.8 ^{de} |
| | 43 | + | 1015 ^{abc} | 14.1 ^{ab} | 2.4 ^{bcd} | 2.6 ^a | 19.0 ^{abcd} |
| | | - | 596 ^{bcd} | 5.5 ^{cd} | 3.8 ^{ab} | 0.4 ^e | 9.7 ^{cde} |
| | 86 | + | 1303 ^a | 16.1 ^a | 2.4 ^{bcd} | 2.4 ^{ab} | 23.4 ^a |
| | | - | 591 ^{bcd} | 7.7 ^{bcd} | 3.0 ^{abc} | 0.9 ^{bcde} | 11.2 ^{bcde} |
| M | 0 | + | 941 ^{abcd} | 11.69 ^{ab} | 1.6 ^{bcde} | 2.3 ^{abc} | 15.6 ^{abcde} |
| | | - | 489 ^{cd} | 4.7 ^{cd} | 3.7 ^{ab} | 0.8 ^{cde} | 9.2 ^{de} |
| | 43 | + | 1043 ^{abc} | 14.5 ^{ab} | 2.5 ^{bcd} | 1.5 ^{abcde} | 18.2 ^{abcde} |
| | | - | 412 ^d | 3.6 ^d | 3.6 ^{abc} | 0.3 ^e | 6.8 ^e |
| | 86 | + | 1104 ^{abc} | 16.8 ^a | 2.5 ^{bcd} | 2.4 ^{ab} | 20.8 ^{abc} |
| | | - | 428 ^{cd} | 4.2 ^{cd} | 2.9 ^{bcde} | 0.2 ^e | 7.5 ^{de} |
| C | 0 | + | 915 ^{abcd} | 11.2 ^{abc} | 1.7 ^{bcde} | 2.3 ^{abcd} | 15.2 ^{abcde} |
| | | - | 551 ^{bcd} | 4.7 ^{cd} | 2.8 ^{ab} | 0.5 ^e | 7.9 ^{de} |
| | 43 | + | 703 ^{abcd} | 14.2 ^{ab} | 2.3 ^{bcd} | 2.6 ^a | 19.1 ^{abcd} |
| | | - | 575 ^{bcd} | 5.0 ^{cd} | 4.0 ^a | 0.8 ^{de} | 9.8 ^{cde} |
| | 86 | + | 1228 ^{ab} | 18.4 ^a | 2.9 ^{abcde} | 3.0 ^a | 22.7 ^{ab} |
| | | - | 606 ^{bcd} | 5.9 ^{cd} | 4.2 ^a | 0.7 ^{de} | 10.8 ^{cde} |
| Sig.level | | | * | ** | * | ** | ** |

Means having the same letters in columns were not significantly different according to Duncan's Multiple Range Test at 5% level.

*, ** = significant at $P \leq 0.05$ and 0.01 , respectively.

U, M and C = urea, manure and combination of both, respectively.

+, - = irrigated and non-irrigated, respectively.

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اثر الري ونوع السماد و معدل النتروجين على مكونات الإنتاج و الإنتاج الكلي للمانجو
بأبي كرشولا، ولاية جنوب كردفان، السودان (*Mangifera indica* L.)

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الخلاصة

أجريت التجربة بأبي كرشولا، ولاية جنوب كردفان، السودان لموسمي 10/2009 و 11/2010 لمعرفة تأثير الري ونوع السماد ومعدل النتروجين على مكونات الإنتاج و الإنتاج الكلي لصنف المانجو المحلي كتشنر. اشتملت المعاملات علي ري أشجار المانجو أو عدم ريهها. مصادر النتروجين كانت يوريا و روث الأبقار و خليط من اليوريا و روث الأبقار. إضيف النتروجين بمعدلات صفر و 43 و 86 كجم N/هكتار. صممت التجربة بطريقة القطع المنشقه مرتين . كانت معاملة الري هي القطعة الرئيسييه ونوع السماد هي القطعه المنشقه ومعدل النتروجين هو القطعه المنشقه و تم تكرارها ثلاث مرات. أظهرت النتائج أن ري أشجار المانجو أدى إلى زيادة معنوية في إنتاج مانجو الصادر و الثمار المخدوشه و عدد الثمار للشجره و الإنتاج الكلي. بينما ادى حجب الماء عن أشجار المانجو إلى أعلى إنتاج للسوق المحلي و أقل ثمار مخدوشه. ادى سماد اليوريا الى أعلى عدد من ثمار المانجو للشجره و أعلى إنتاج للسوق المحلي وأعلى إنتاج كلي في الموسمين. كما ادى خلط اليوريا و ماروق روث الأبقار بنسبة 50% لكل إلى زيادة معنوية في إنتاج الصادر في الموسمين. بينما اعطى سماد ماروق روث الابقار أقل إنتاج كلي و عدد الثمار للشجرة في الموسمين. ادت إضافة السماد إلى زيادة معنوية في عدد الثمار للشجره و إنتاج الصادر و الإنتاج الكلي في الموسمين بينما ادى معدل 86 كجم N/هكتار إلى أعلى إنتاج لمانجو الصادر و إنتاج كلي في الموسمين مقارنة بمعدل 43 كجم N/هكتار. توصى الدراسة بري أشجار المانجو وإضافة النتروجين في شكل خليط من اليوريا و ماروق روث الأبقار بمعدل 86 كيلوجرام N / هكتار لزيادة الإنتاج الكلي وإنتاج الصادر.