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Short Communication

Growth and yield of Kinnow mandarin on N fertigation and drip-irrigation in Kandi area of Punjab

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The water resources on the earth are limited, with freshwater being estimated at 37 million km^3. Only 0.3% of this amount can be used as renewable resource. The lack of water is the major limiting factor on expansion of irrigated agriculture in the arid and semi-arid land of the world. Establishment of water-saving irrigation technology for irrigation is considered to be one of the efficient ways to improve and to develop agriculture in the 21st century in these regions. Fertigation - a modern agro-technique provides an excellent opportunity to maximize yield and minimize environmental pollution (Hagin *et al.* 2002) by increasing fertilizer use efficiency, minimizing fertilizer application and increasing return on the fertilizer invested. The application of fertilizers is highly site-specific, depending on soil type, climatic conditions and water quality. Fertilizer demand in intensive plant production systems is particularly variable, changing rapidly during the season and the year. The nutrient requirements of Kinnow mandarin trees are very much dependent on the biological stage of growth and varying from vegetative to fruiting periods. Using micro irrigation system for Kinnow production has greatly increased the adaptation of fertigation products. Bravdo *et al.* (1993) stated that shoot growth extension varied considerably according to irrigation system. El-Wazzan *et al.* (2001) on Valencia orange improved that irrigation system had amounced effect on the yield. Assuming that frequent N fertigation over most of the growing season stimulate vegetative growth due to the constant availability of N to plant. This work aimed to investigate the effect of varying amount of drip irrigation and N fertigation on the vegetative growth and the yield of Kinnow mandarin trees.

A study was carried out for investigating the varying N fertigation rates 400, 600, 800 and 1000 gm N/ tree and annually added at 21, 23, 30 and 34 equal doses on the vegetative growth and yield of Kinnow orchards of six year old in Kandi area located in foothills of Shivalik (Punjab) during four successive years from 2011-14. The amount of water applied via drip irrigation was 16, 20, 24 and 30 m^3/ tree per year and different combinations between them were also studied. Average spring shoot length (cm) - number of leaves per spring shoot- leaf area (cm^2)-percentage of N and P of the leaves, fruit yield were determined according to standard methods. The data was statistically analyzed according to Panse and Sukhatme (2009). The different combinations of (a) = quantity of water applied and (b) = N fertigation frequencies were as a_1b_1, a_1b_2, a_1b_3, a_1b_4, a_2b_1, a_2b_2, a_2b_3, a_2b_4, a_3b_1, a_3b_2, a_3b_3, a_3b_4, a_4b_1, a_4b_2, a_4b_3 and a_4b_4.

Varying quantities of water applied via drip irrigation from 16-30 m^3 water /tree/year had a positive effect on shoot length, number of leaves/shoot and leaf area of Kinnow mandarin. The vegetative growth was stimulated with increasing quantities of water per tree (16-30 m^3 water/tree/year). Higher differences in these growth aspects were detected among all levels except the two higher ones. The maximum and minimum values were detected on the trees irrigated with water at 30 and 16 m^3 per tree, respectively (Figure 1-3). Results indicated that growth parameters of Kinnow mandarin trees were gradually stimulated with increasing levels of nitrogen fertigation from 400-1000 gm/tree. Maximum differences of these growth traits were observed between all levels of N except between 800 and 1000 gm N/tree. The results are in agreement with those of Sharawy (2005) on Balady lime trees. Increasing nitrogen frequencies from 21 to 23 affect in positive manner these vegetative parameters (shoot length, Number of leaves per shoot and leaf area). Increasing nitrogen frequencies from 30-34 had in most cases a slight effect. Combinations between quantities of water and nitrogen fertigation levels and frequencies had a great effect on growth characters of Kinnow mandarin trees (Fig 1-3). The maximum values were obtained with irrigation the trees with 30 m^3 water and added 1000 gm N at 23 doses. These results are in harmony with the results of Koulka *et al.* (2000) on Balady orange trees. There was a progressive increase on the percentages of N and P in the leaves of non- fruiting shoots of Kinnow mandarin trees with increasing water quantities applied via drip irrigation from 16 to 30 m3/tree/years. The important role of water in increasing nutritional status of the trees was emphasized by Nakhlla *et al.* (1998) on Navel orange trees. Increasing nitrogen fertigation from 400 to 1000 gm N/tree was followed by a gradual promotion on percentage of N in the leaves. These results were supported by those of Sharawy (2005) on Balady lime trees. Increasing quantities of water applied via drip irrigation from 16 to 30 m^3 water/tree/year caused a gradual promotion on the yield expressed as kgs (Fig 10-12). The two higher rates of applied water (24 and 30 m^3 water/tree/year) did not concerning their influence on the yield per tree. Therefore, the recommended amount of water added to Kinnow mandarin trees for gaining an economical yield at 24 m^3 water/tree/year (Fig. 10). Increasing N fertigation from 400-1000 gm N/tree resulted in increase in the yield/tree (Fig. 11). Similar results were reported in navel orange by Thompson *et al* (2002); Schumann *et al* (2003).The difference between 800 and 1000 gm N/tree was meaningless. Fruit TSS (°Brix) was recorded highest 24 m^3 water/tree/year and 800gm N/tree and 23 doses (Fig 13-15). Similar results were reported by the Alva *et al.* (2006) in Valencia orange. As a conclusion, one can state that adding water at 24 m^3 /tree annually and nitrogen at 800 gm via drip irrigation is recommended.

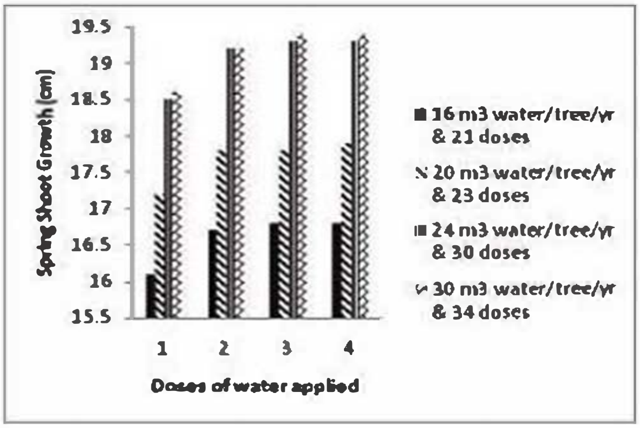


Fig. 1.

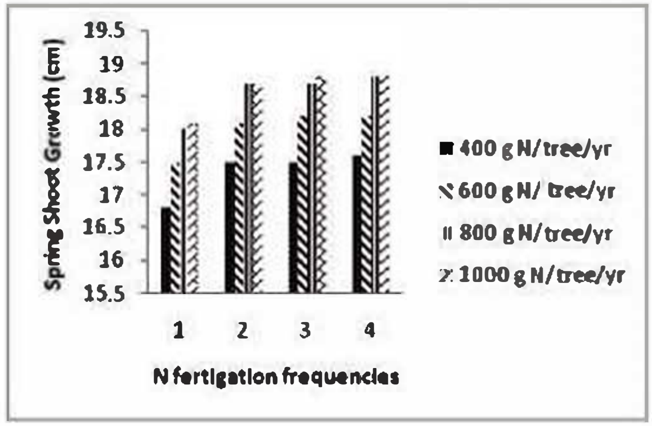
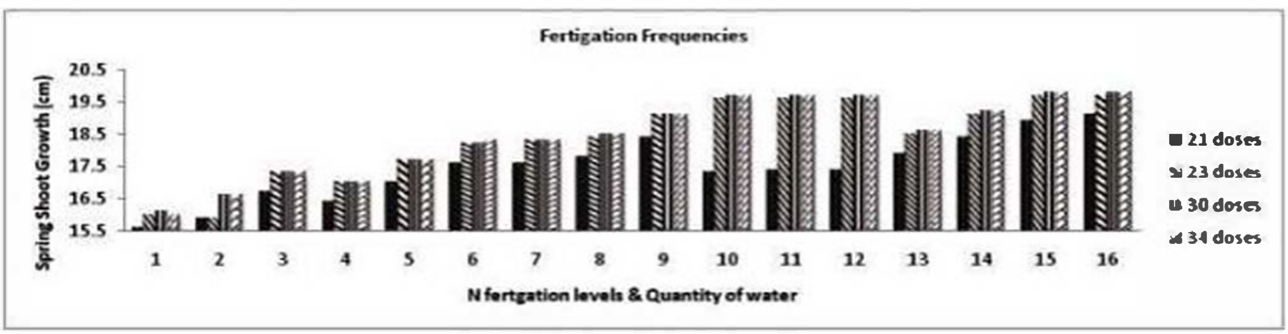


Fig. 2.



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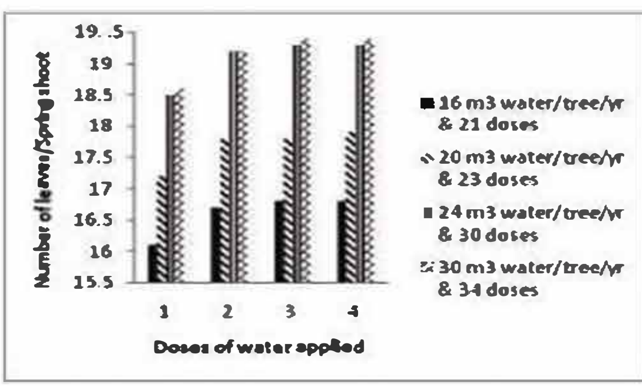

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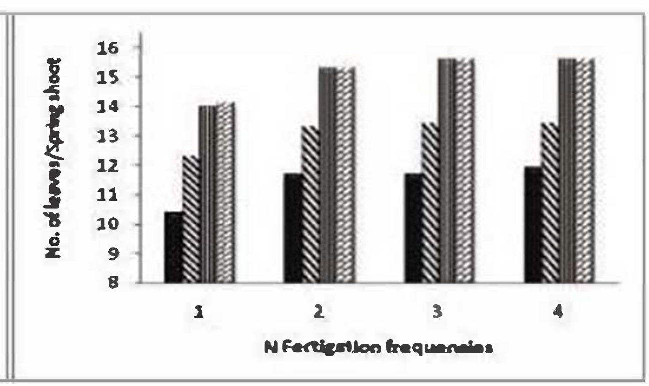

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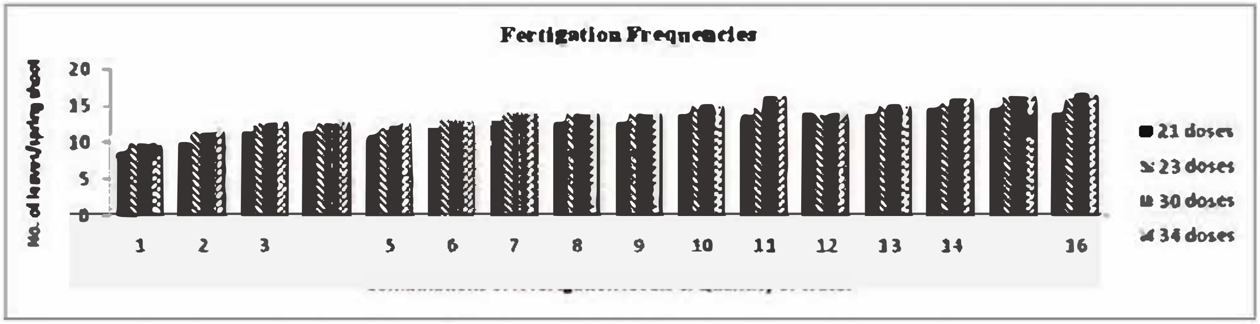

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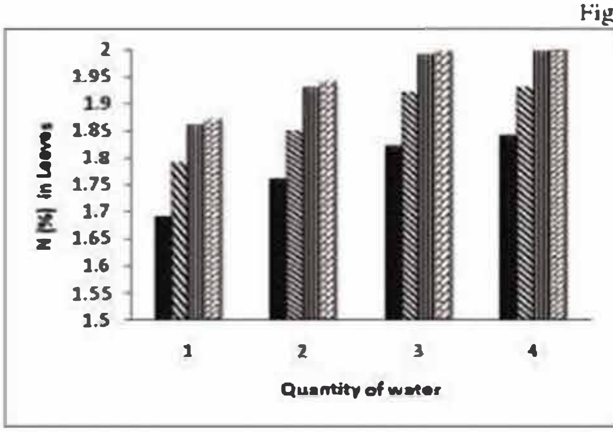

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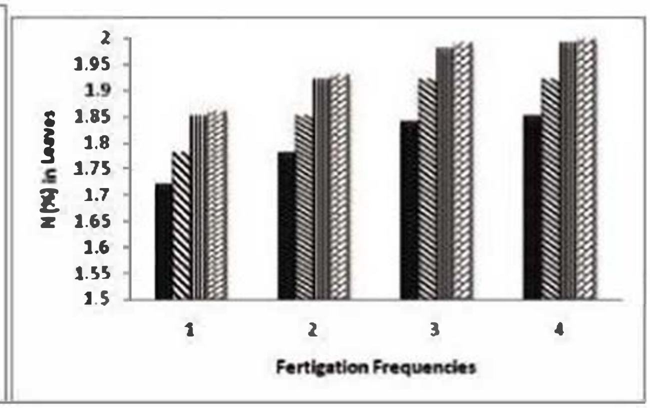

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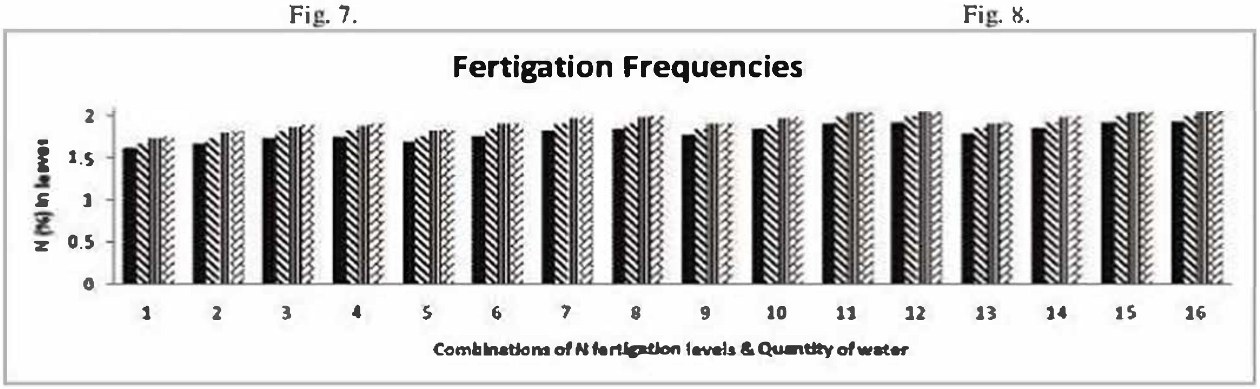


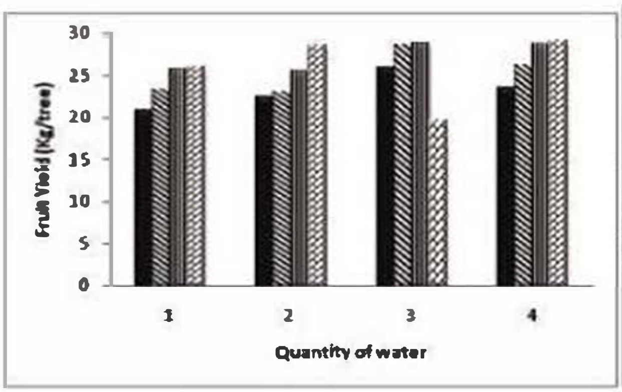


Fig. 9.

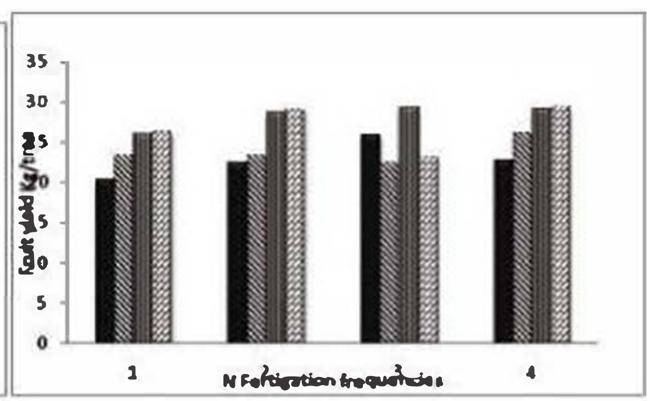


Fig. 10.

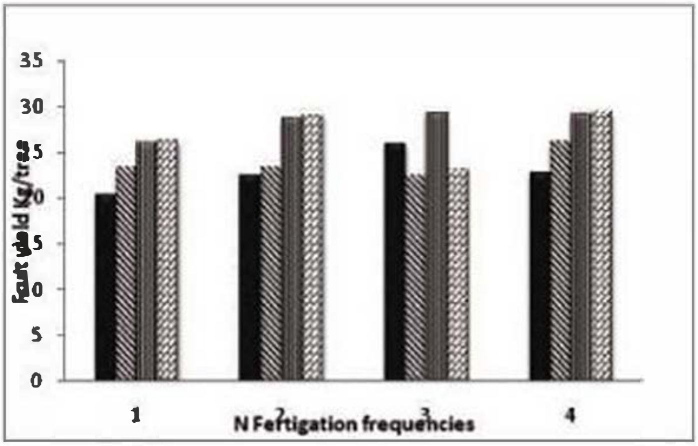
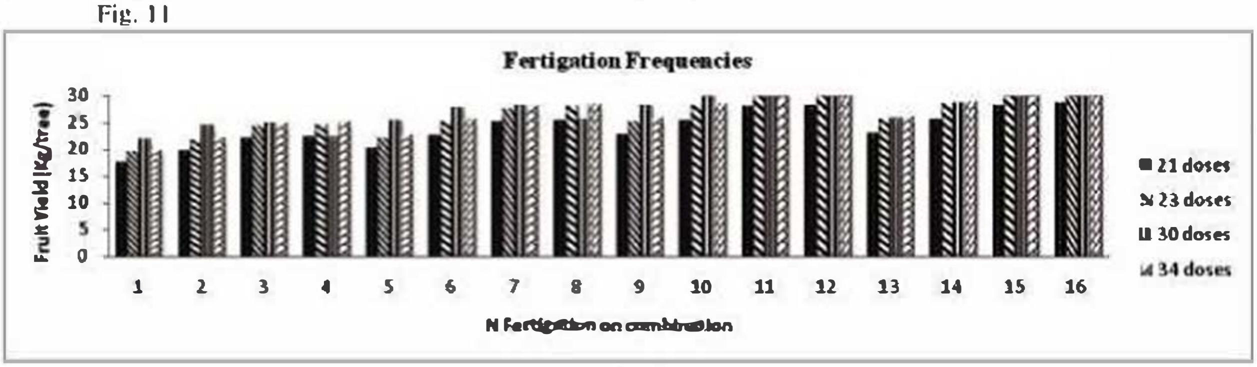


Fig. 11



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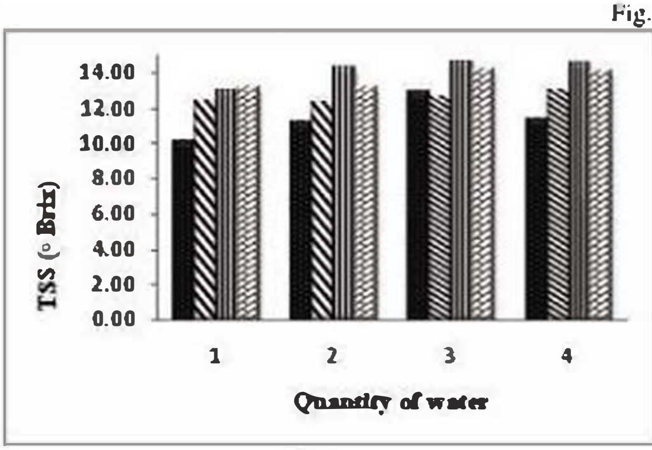

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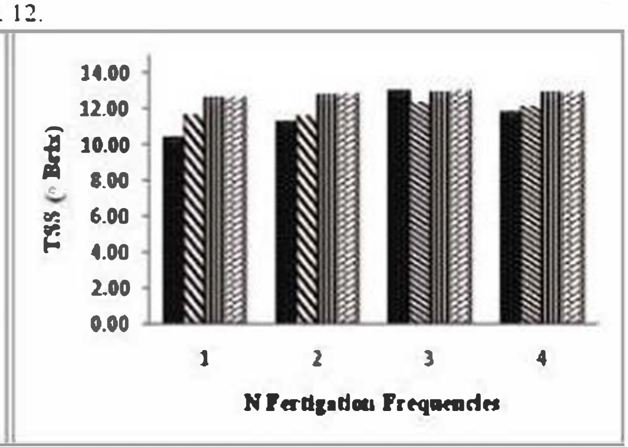

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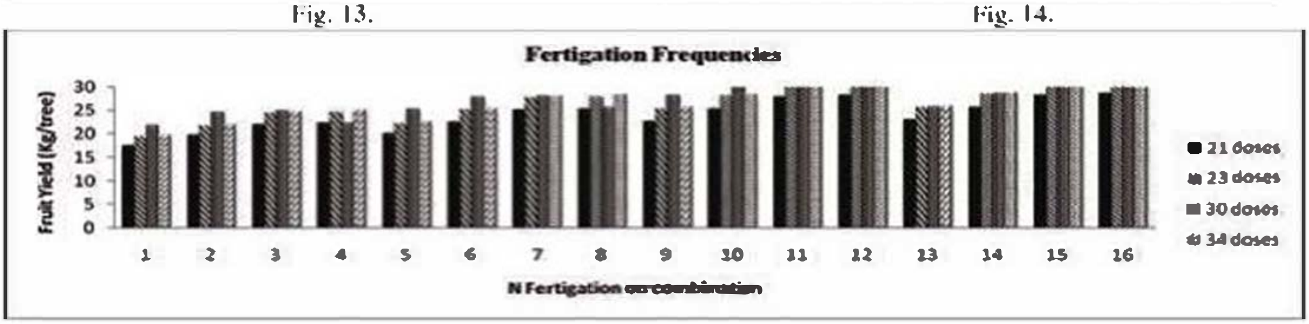

Fig. 14.