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Effect of Pruning, Micronutrients and Plant Growth Regulators on Kinnow Mandarin Fruits

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An experiment on effect of pruning, micronutrients and PGRs on the plant spread, pre-harvest fruit drop and quality of Kinnow Mandarin fruit was studied. The experiment was arranged into Randomised Block Design with 13 treatments and replicated thrice. Two foliar sprays at 15 days interval were carried out in the month of November on both plants (pruned and un-pruned plant). The results revealed that the combine application of pruning, zinc sulphate (250 ppm) and GA_3 (50 ppm) showed better performance significantly increases the plant height, number of fruits and decreases the pre-harvest fruit drop, peel thickness, acidity of fruits. In case of combine applications of pruning, zinc sulphate (250 ppm) and kinetin (50 ppm) significantly increased spread, girth of plant and weight of the fruits and pruning with boron (250 ppm) and GA_3 (50 ppm) increased the TSS, TSS/acid ratio and ascorbic acid.

Keywords: Kinnow Mandarin, Pruning, Micronutrients, PGRs.

Citrus fruits hold an important place in the economy of our country and this fruit form the third largest fruit industry. This fruit are an excellent source of ascorbic acid and protects from the scurvy disease, a disease commonly associated with inadequate availability of vitamin C in the dietary foods. In India Kinnow area was 48182 hectares with 1108618 tonnes production during 2014-15 reported by Ladaniya(2015). Kinnow is a hybrid variety of mandarin which is cultivated Rajasthan, Haryana and Himachal Pradesh States with Punjab in India.Kinnow has naturally sympodial growth habit, farming an outsized bush (eighteen - twenty feet tall) if neglect of pruning. Pruning, the considered removal of any vegetative part and watery branches, may be a very important culture operation for the mature trees. And the most object of pruning increased the plant height, spread, girth and provide most fruit of fine quality by maintaining a balance between vegetative and mature wood.The nutrition constitutes an important component of successful and healthy citrus cultivation. The micronutrients on the other hand though are needed in few quantities which is very helpful in plant metabolism activity. The severe deficiency of Zn and B in the orchards of citrus has been noted and observed that Zn & B is more helpful for prevent of fruit drop and in improving fruit quality of citrus (TSS, Ascorbic acid etc.). Another main problem is the pre-harvest fruit drop and low yield and for controlling the problem plant growth regulators can be used to control the excessive fruit drop. Application of PGRs including GA_3 and Cytokinins for quality fruit production is well documented in mature trees of Citrus. The auxins and gibberellins are also used for management of pre-harvest drop of the citrus fruits and provides excellent quality of the fruits.

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MATERIALS AND METHODS

Experiment Site and Treatment

The field experiment was conducted during the years 2016-17 in the orchard of Kinnow located at Horticulture Research farm of Lovely Professional University, Phagwara (Punjab). To study, trees were selected at the 9 years old, productive, uniform and free from the pests and diseases with 6 × 6 square meter spacing. And Kinnow plant was divided into three group (pruned, un-pruned and control). Plants were light pruned (20-25cm) just after the fruit harvesting (third week of January). The micronutrients (zinc sulphate, boron solution) with the plant growth regulators (GA_3, NAA and kinetin) were sprayed in the month of November (twice) in pruned (six treatments) and un-pruned (six treatments) plants separately. And one treatment was kept as control. Total 39 experimental plants were elite at random during this trial and the trial was set go into the randomized block design with factorial arrangement. There were three replication with a unit of three plants in each treatments.

Observations recorded

Vegetative Parameters Determination

Vegetative parameters observation viz., the plant height, spread and girth were recorded from the experimental plants. For this purpose, shoots were selected randomly by selecting one branch in each direction of all the experimental plants. Plant height, spread and girth is determined with the help of measuring tape. In case of pruned plant all the observation were taken viz. before pruning, after pruning and after harvesting as well as un-pruned and control except after pruning. And number of fruit at maturity counted in last week of October and counted at harvesting time (second week of January) of fruits. Both were most helpful for the determined of pre-harvest fruits drop.

Physical and Chemical Parameters Determination

For the physical and chemical parameters determination nine fruits were randomly collected from all sides of the trees under treatments and both physical characteristics [fruit weight (gm.) and Peel thickness (cm)] and chemical characteristics [TSS (%), TSS/Acidity ratio, Acidity (%) and Vitamin C (%)] were determined by the methods described by AOAC.

Experimental design and statistical analysis

The data was analysed by RBD design. And (ANOVA) was calculated by theusing ofOPSTAT software.

RESULTS AND DISCUSSION

The analysed pooled data regarding vegetative, physical and chemical parameters are given in table-1 and table-2. And all parameter data was founded significant except fruit weight.

Plant Height

The result obtained showed the maximum increase height (44.17 cm) from the T_1 and followed by the T_2 (42.40 cm). And minimum increases plant height (28.47 cm) was observed in T_{13}. The micronutrients especially Zn increases the growth parameters in young trees of Washington

Treatment Details:

$T_1 – P_1 + M_1 + G_1$ (pruning + zinc + gibberelic acid)
$T_2 – P_1 + M_1 + G_2$ (pruning + zinc + naphthalene acetic acid)
$T_3 – P_1 + M_1 + G_3$ (pruning + zinc + kinetin)
$T_4 – P_1 + M_2 + G_1$ (pruning + boron + gibberelic acid)
$T_5 – P_1 + M_2 + G_2$ (pruning + boron+ naphthalene acetic acid)
$T_6 – P_1 + M_2 + G_3$ (pruning + boron + kinetin)
$T_7 – P_2 + M_1 + G_1$ (un-pruning + zinc + gibberilic acid)
$T_8 – P_2 + M_1 + G_2$ (un-pruning + zinc +naphthalene acetic acid)
$T_9 – P_2 + M_1 + G_3$ (un-pruning + zinc + kinetin)
$T_{10} – P_2 + M_2 + G_1$ (un-pruning + boron + gibberelic acid)
$T_{11} – P_2 + M_2 + G_2$ (un-pruning + boron + naphthalene acetic acid)
$T_{12} – P_2 + M_2 + G_3$ (un-pruning + boron + kinetin)
T_{13}— Control

Table 1. Effect of pruning, micronutrients and PGRs on vegetative parameters in Kinnow Mandarin.

Treatments	Plant spread E-W(cm)	Plant spread N-S(cm)	Plant height (cm)	Plant girth (cm)	No. of fruits reach to maturity/ plant	Pre-harvest fruits drop (%)	No. of fruits at harvesting time/plant
$T_1(P_1+M_1+G_1)$	41.70	39.67	44.17	4.03	800.33	13.12	695.33
$T_2(P_1+M_1+G_2)$	42.50	39.10	42.40	3.90	703.33	12.68	614.00
$T_3(P_1+M_1+G_3)$	43.97	38.47	42.17	4.23	678.33	16.57	566.33
$T_4(P_1+M_2+G_1)$	38.33	36.00	40.63	3.53	723.00	15.62	610.00
$T_5(P_1+M_2+G_2)$	37.70	40.03	41.40	3.77	743.33	15.49	628.00
$T_6(P_1+M_2+G_3)$	39.50	35.97	39.83	3.60	727.00	19.31	585.66
$T_7(P_2+M_1+G_1)$	38.73	34.80	37.97	3.20	626.00	21.19	493.00
$T_8(P_2+M_1+G_2)$	39.30	35.03	37.53	2.87	659.00	21.87	515.00
$T_9(P_2+M_1+G_3)$	38.43	34.63	38.53	3.20	639.67	23.22	491.33
$T_{10}(P_2+M_2+G_1)$	37.40	35.67	33.40	3.37	564.67	23.45	431.67
$T_{11}(P_2+M_2+G_2)$	37.07	35.70	37.13	3.67	614.33	25.71	457.00
$T_{12}(P_2+M_2+G_3)$	37.60	35.67	33.03	3.07	574.00	31.91	391.00
T_{13}(Control)	33.53	32.93	28.47	2.67	604.67	52.50	287.67
C.D.	1.51	0.92	0.64	0.35	59.75	4.59	57.98
SE(m)	0.51	0.31	0.22	0.12	20.35	1.56	19.75
SE(d)	0.72	0.44	0.30	0.17	28.78	2.21	27.92
C.V.	2.29	1.49	0.98	6.05	5.29	12.04	6.57

(T=Treatment, P_1=Pruning, P_2=Un-pruning, M_1=Zinc, M_2=Boron, G_1=Gibberellic acid, G_2=NAA, G_3=Kinetin, E-W=East-West, N-S=North-South, C.D.=Critical Difference, SE(m)=Standard Error mean, SE(d)=Standard Error deviance, C.V.=Correlation of Variance)

Table 2. Effect of pruning, micronutrients & PRGs on physical and chemical parameters in Kinnow Mandarin

Treatments	Fruit weight (gm.)	Peel thickness (cm)	TSS (%)	TSS Acid ratio	Total acidity (%)	Ascorbic acid(mg/ 100gm)
$T_1(P_1+M_1+G_1)$	206.85	0.34	12.07	17.05	0.71	32.50
$T_2(P_1+M_1+G_2)$	225.94	0.39	11.33	9.77	1.19	31.08
$T_3(P_1+M_1+G_3)$	258.02	0.41	10.40	8.49	1.24	30.86
$T_4(P_1+M_2+G_1)$	199.03	0.94	12.17	14.14	0.89	34.75
$T_5(P_1+M_2+G_2)$	182.90	0.33	11.73	6.48	1.71	29.42
$T_6(P_1+M_2+G_3)$	238.82	0.47	10.47	7.46	1.70	27.50
$T_7(P_2+M_1+G_1)$	246.66	0.34	10.27	11.18	0.93	31.92
$T_8(P_2+M_1+G_2)$	217.93	0.43	10.07	5.42	1.92	28.59
$T_9(P_2+M_1+G_3)$	208.03	0.43	10.33	7.99	1.29	30.58
$T_{10}(P_2+M_2+G_1)$	247.26	0.45	9.27	9.74	0.99	24.75
$T_{11}(P_2+M_2+G_2)$	243.07	0.50	10.47	7.49	1.43	33.25
$T_{12}(P_2+M_2+G_3)$	229.15	0.35	8.93	6.07	1.49	16.42
T_{13}(Control)	171.03	0.43	9.13	8.78	1.05	17.50
C.D.	NS	0.11	1.27	3.23	0.51	7.61
SE(m)	19.05	0.04	0.43	1.10	0.17	2.59
SE(d)	26.93	0.05	0.61	1.55	0.24	3.66
C.V.	14.91	14.79	7.17	20.63	23.91	15.81

(T=Treatment, P_1=Pruning, P_2=Un-pruning, M_1=Zinc, M_2=Boron, G_1=Gibberellic acid, G_2=NAA, G_3=Kinetin, C.D.=Critical Difference, SE(m)=Standard Error mean SE(d)=Standard Error deviance, C.V.=Correlation of Variance, NS=Non-Significant)

Navel Oranges has been observed by Dawood et. al (2001).

Plant girth

The maximum increases girth (4.23 cm) in the T_3 and minimum increases girth (2.67 cm) was noted in T_{13}. These results are in line with that of Bisla et. al (1990)who reported that the pruned trees produce maximum girth than compared to un-pruned trees in ber.

Plant spread

plant spread divided in two way viz., east-west and north-south direction. In case of East-West direction the maximum increases spread (43.97 cm) was observed in T_3 and minimum increases spread (33.53 cm) in the T_{13}. And in case of North-South direction the maximum increases spread (40.03 cm) was noted in T_5 and minimum (32.93 cm) was in the T_{13}.

Number of fruits reach to maturity/plant

The maximum numbers of fruits (800.33) were noted in T_1 (pruned) and minimum numbers of fruits (564.67) were obtained by the T_{10} (un-pruned) at the time of reach to maturity. So results are outcomes that pruning is more helpful for the increases in number of fruits in the plant. These findings are supported bySingh et. al (2004) who reported that trees, which have begun to decline in vigour, size and yield of fruit require pruning for the restore their condition.

Pre-harvest fruit drop (%)

The maximum pre-harvest fruit dropped (52.50%) were observed in T_{13} and minimum dropped of fruits (12.68%) were noted in T_2. NAA checking the fruit drop and increase the fruit size. These results are accordance with the results of Choudhari et. al (1982) in sweet orange.

Numberof fruits at harvesting time/plant

The maximum number of fruits (695.33) per plant was obtained by the T_1 and followed by(628) fruits in T_5. And the minimum number of (287.67) fruits per plant noted in the T_{13} at the time of harvesting. Zinc is very effective in stimulating number of the fruits with physical and chemical characters of fruits rather compare to the control has been founded byKhafagy et. al (2010).

Fruit weight

The maximum weight of fruit (258.02g) was noted in T_3 and followed by the T_{10} (247.26g). And minimum weight of fruit (171.04g) was achieved by the T_{13}. And results were outcomes that the combination application of pruning, zinc and kinetin are able to increased fruit weight. These outcomes are also correlated with the findings byAsadi and Akhlagi(2005).

Peel thickness

The minimum thickness (0.34cm) was obtained by the T_1 and maximum (0.94cm) in the T_4. And results were noted that combine application of the pruning, zinc and GA_3 is most effective for the reduction peel thickness of the fruits.

Total soluble solids

The maximum T.S.S (12.17%) was founded in T_4 and minimum T.S.S. (8.93%) was observed in T_{12}. And results were obtained that uses the combine application of pruning, boron and GA_3 are able to extend the T.S.S. of fruits. The findings of Shinde et. al (2008) support these results, where he noted that extend of the T.S.S contents due to applying of GA_3 50 mg/l in citrus orchard.

T.S.S/Acid Ratio

The maximum TSS/acid ratio (17.05:1) was found in T_1 and minimum ratio (5.42:1) was noted in T_8. And 8.7:1 to 14.5:1 was observed by Josan et. al (1994)which are in close accordance with the findings of present investigations.

Acidity

The maximum acidity (1.92%) was noted in the T_8 and the minimum acidity (0.71%) was noted in T_1. It has been reported from 0.8 to 1.7 percent by Sandhu and Randhawa(1994).

Ascorbic acid

The maximum ascorbic acid (34.75mg/100gm.) was observed in T_4 and followed by the (33.25mg/100gm) in $T_{11.}$ And the minimum ascorbic acid (16.42mg/100gm) was noted in T_{12}. And the foliar spraying of Valencia orange trees with Chelated zinc and boron significantly increased fruit quality in comparison to control and other treatments observed by Baghdady et. al (2014). The production of auxin (mainly NAA) increases vitamin C in Kinnow mandarin fruits as reported by Nawaz et. al (2008).

CONCLUSION

The study revealed that application of pruning + zinc (250ppm) + GA_3 (50ppm) days showed better performance in plant spread and

number of fruit, fruit weight, TSS, acidity, ascorbic acid and was most helpful for the reduction of pre-harvest drop of Kinnow fruit.

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