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Effect of Pruning Intensities under Different Levels of Irrigation and Nitrogen on Fruit Set and Yield of Plum cv. *Santa rosa*

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A B S T R A C T

An experiment was conducted to standardize the renewal pruning intensities under different irrigation and nitrogen levels for getting better yield and quality fruits in *Santa Rosa* plum. There were three irrigation levels, four pruning severities and two nitrogen levels. Pruning was done in the month of January every year. Pruning treatments exhibited a significant effect on fruit set during both the years of study. Among all the pruning treatment highest fruit set and yield was found in T_3 treatment and lowest in T_1 treatment. In N-fertilization higher yield was observed with N_1 treatment as compared to N_2 treatment. Plants irrigated at 20 per cent soil moisture depletion of field capacity showed highest yield and fruit set while the lowest was found in 60 per cent soil moisture depletion of field capacity.

Introduction

Among the stone fruits, '*Santa Rosa*' plum (*P. salicina*) is one of the important fruit crop of the temperate regions. Efficient orchard management practices have a key role in enhancing the productivity of plums. Pruning, nitrogen fertilization, and irrigation are important cultural practices which affect yield and quality in plums. Work on the standardization of plum and fertilizer requirement of plum have been conducted separately by several workers under different set of agro-climatic conditions, but virtually no work has been carried out to standardize the optimum levels of pruning, irrigation and N-fertilization for regular and quality production of *Santa Rosa* plum. Keeping these facts in view, the present studies were undertaken.

Materials and Methods

The present studies were undertaken in the experimental orchard of Department of pomology, Dr. Y. S. Parmar University of

Horticulture and Forestry, Solan (H.P) during 2010-2012. Seventy two trees of *Santa Rosa* plum with equal age and vigour, spaced at 6 m x 6 m were selected for trial purpose. The experiments was laid out in split-split plot design with, irrigation levels as the main plot, pruning levels as the Sub-plots and nitrogen levels as the Sub-Sub-plot treatment. The experimental unit consisted of a single tree. There were three irrigation levels, four pruning severities and two nitrogen levels with three replications.

Three irrigation levels are –

I_1 – Irrigation at 20 per cent soil moisture depletion of field capacity

I_2 – Irrigation at 40 per cent soil moisture depletion of field capacity

I_3 – Irrigation at 60 per cent soil moisture depletion of field capacity

There were four pruning severities –

T_1 – Heading back of scaffolds (75 percent)

T_2 – Heading back of scaffolds (50 percent)

T_3 – Heading back of scaffolds (25 percent)

T_4 – Normal pruning

Heading back of scaffolds 75%:- Shortening of scaffolds branches was done by $3/4^{th}$ and consisted of 45 to 50 percent thinning out.

Heading back of scaffolds 50%:- In this treatment the shortening of scaffolds branches was done by $1/2$ and 45 to 50 percent thinning out. Heading back of scaffolds 25%:- It consists of shortening of shoots by $1/3^{rd}$ and 45 to 50 percent thinning out.

Normal pruning: - In this system recommended practice of pruning is followed. Pruning was done in January every year.
There were two nitrogen levels i-e, N1, and N_2

N_1 – 75 percent additional nitrogen of recommended dose as CAN

N_2 – 50 percent additional nitrogen of recommended dose as CAN

Nitrogen was applied through CAN (25% N), phosphorus through SSP (16% P_2O_5) and potassium through muriate of potash (60% K_2O). CAN was applied to soil in the month of February by broad-casting evenly under the trees starting 30 cm away from the tree trunk. The S.S.P and MOP were placed in alternate circular trenches 23 to 30 cm deep and 15 to 18 cm wide. The fertilizers were spread evenly in the tree basin and mixed thoroughly in the soil surface.

Yield was recorded as the total fruit weight harvested from the tree in each year and expressed as kg/tree. The pooled analysis (over years) was done.

Results and Discussion

The data on the effects of different irrigation, pruning intensity and nitrogen fertilization treatments with respect to fruit set are presented in Table 1a to 1c. Different levels of irrigation exhibited significant effect on fruit set.

The maximum fruit set was recorded in trees irrigated at 20 per cent soil moisture depletion of field capacity. These results are in line with the findings of Zani (10), who observed marked increase in fruit set in peaches under higher soil moisture levels.

Agabbio (1) also recorded a significant increase in fruit set of apricot with frequent

irrigation. pruning treatments has significant effect on the fruit set during both the year of study. The results are in conformity with the findings of Singh (8), Daulta and Singh (3), Singh (7) and Thakur (9).

The reduction in fruit setting in T_1 treatment (HB of scaffolds 75%) may be due to the active utilization of Carbohydrates nutrients and water by the newly growing vegetative shoots. Trees irrigated at 20 per cent soil moisture depletion of field capacity gave significantly higher yield as compared to 60 percent soil moisture depletion of field capacity. These results are in line with those of Marangoni *et al.,* (5) and Sharma and Chandel (6).

Table.1a Effect of different levels of irrigation, pruning and nitrogen on fruit set (%) and fruit yield (kg tree^{-1})

Treatments	Fruit set (%)			Fruit yield (kg tree^{-1})		
	2010-11	2011-12	Pooled	2010-11	2011-12	Pooled
Irrigation levels (Main Plot Treatment)						
I_1 (20% SMD of field capacity)	7.22 (2.63)	15.33 (3.65)	11.28 (3.09)	7.75 (2.70)	24.33 (4.39)	16.04 (3.54)
I_2 (40% SMD of field capacity)	6.41 (2.49)	11.19 (3.11)	8.80 (2.70)	7.05 (2.58)	22.20 (4.16)	14.63 (3.35)
I_3 (60% SMD of field capacity)	5.95 (2.37)	7.71 (2.54)	6.83 (2.32)	6.44 (2.48)	18.03 (3.69)	12.24 (3.02)
$CD_{0.05}$	**0.07**	**1.42**	**0.10**	**0.05**	**0.10**	**0.06**
Pruning (Sub plot treatment)						
T_1 (Heading back of scaffolds 75%)	0.00 (1.00)	2.25 (1.45)	1.12 (1.031)	0.00 (1.00)	1.01 (0.99)	0.50 (0.69)
T_2 (Heading back of scaffolds 50%)	2.47 (1.83)	5.97 (2.41)	4.22 (2.02)	3.00 (1.98)	9.81 (3.11)	6.41 (2.51)
T_3 (Heading back of scaffolds 25%)	12.42 (3.66)	19.84 (4.40)	16.13 (3.99)	13.14 (3.75)	39.24 (6.25)	26.19 (5.11)
T_4 (Normal Pruning)	11.24 (3.49)	17.58 (4.14)	14.41 (3.77)	12.20 (3.63)	36.02 (5.98)	24.11 (4.90)
$CD_{0.05}$	**0.06**	**0.10**	**0.07**	**0.05**	**0.06**	**0.03**
Nitrogen (Sub-sub plot treatment)						
N_1 (75% additional N as CAN)	6.75 (2.54)	12.14 (3.25)	9.58 (2.81)	7.27 (2.62)	22.39 (4.18)	14.84 (3.38)
N_2 (50% additional N as CAN)	6.21 (2.45)	10.41 (2.95)	8.36 (2.59)	6.88 (2.56)	20.65 (3.98)	13.77 (3.23)
$CD_{0.05}$	**0.03**	**0.07**	**0.04**	**0.05**	**0.03**	**0.02**

Table.1b Effect of different interaction I x T, I x N and T x N on fruit set (%) and fruit yield (kg tree^{-1})

Interactions	Fruit set (%)			Fruit yield (kg tree^{-1})		
	2010-11	2011-12	Pooled	2010-11	2011-12	Pooled
I_1T_1	0.00 (1.00)	3.39 (1.83)	1.695 (1.29)	0.00 (1.00)	1.38 (1.17)	0.69 (0.83)
I_1T_2	3.59 (2.13)	8.03 (2.83)	5.81 (2.40)	3.89 (2.20)	12.13 (3.48)	8.01 (2.82)
I_1T_3	13.11 (3.75)	26.25 (5.10)	19.68 (4.42)	13.95 (3.86)	43.91 (6.62)	28.93 (5.37)
I_1T_4	12.21 (3.63)	23.64 (4.85)	17.93 (4.23)	13.16 (3.76)	39.90 (6.31)	26.53 (5.15)
I_2T_1	0.00 (1.00)	2.16 (1.46)	1.08 (1.03)	0.00 (1.00)	1.08 (1.00)	0.50 (0.70)
I_2T_2	2.57 (1.88)	6.11 (2.47)	4.34 (2.08)	2.80 (1.94)	10.22 (3.19)	6.51 (2.55)
I_2T_3	12.22 (3.63)	19.75 (4.44)	15.99 (3.99)	13.08 (3.75)	39.70 (6.30)	26.39 (5.13)
I_2T_4	10.87 (3.44)	16.72 (4.08)	13.79 (3.70)	12.34 (3.65)	37.86 (6.15)	25.10 (5.01)
I_3T_1	0.00 (1.00)	1.20 (1.07)	0.60 (0.75)	0.00 (1.00)	0.64 (0.79)	0.32 (5.59)
I_3T_2	1.24 (1.49)	3.77 (1.93)	2.50 (1.57)	2.30 (1.81)	7.10 (2.65)	4.70 (2.16)
I_3T_3	11.93 (3.59)	13.52 (3.67)	12.72 (3.56)	12.38 (3.65)	34.10 (5.83)	23.24 (4.81)
I_3T_4	10.65 (3.41)	12.37 (3.51)	11.51 (3.39)	11.09 (3.47)	30.29 (5.49)	20.69 (4.54)
$CD_{0.05}$	**0.11**	**2.11**	**0.15**	**0.11**	**0.11**	**0.05**
I_1N_1	7.46 (2.67)	16.56 (3.80)	12.02 (3.19)	8.03 (2.75)	25.01 (4.46)	16.52 (3.60)
I_1N_2	6.99 (2.58)	14.09 (3.51)	10.54 (2.98)	7.47 (2.66)	23.65 (4.33)	15.56 (3.48)
I_2N_1	6.79 (2.55)	12.16 (3.25)	9.47 (2.81)	7.11 (2.59)	22.74 (4.22)	14.93 (3.39)
I_2N_2	6.03 (2.42)	10.21 (2.97)	8.12 (2.59)	6.99 (2.57)	21.66 (4.10)	14.33 (3.31)
I_3N_1	5.99 (2.39)	8.51 (2.71)	7.25 (2.42)	6.68 (2.52)	19.43 (3.87)	13.06 (3.14)
I_3N_2	5.91 (2.35)	6.91 (2.38)	6.41 (2.21)	6.20 (2.44)	16.64 (3.51)	11.42 (2.89)
$CD_{0.05}$	**0.05**	**1.02**	**0.05**	**NS**	**0.05**	**0.03**
T_1N_1	0.00 (1.00)	2.60 (1.58)	1.30 (1.12)	0.00 (1.00)	1.11 (1.05)	0.55 (0.74)
T_1N_2	0.00 (1.00)	1.89 (1.32)	0.94 (0.93)	0.00 (1.00)	0.90 (0.92)	0.45 (0.65)
T_2N_1	2.84 (1.93)	6.41 (2.51)	4.62 (2.12)	3.19 (2.03)	10.51 (3.23)	6.85 (2.60)
T_2N_2	2.09 (1.74)	5.53 (2.31)	3.81 (1.92)	2.80 (1.94)	9.12 (2.99)	5.96 (2.42)
T_3N_1	12.55 (3.68)	21.61 (4.60)	17.08 (4.11)	13.51 (3.80)	40.70 (6.37)	27.10 (5.20)
T_3N_2	12.29 (3.64)	18.07 (4.20)	15.18 (3.88)	12.76 (3.70)	37.78 (6.13)	25.27 (5.02)
T_4N_1	11.61 (3.54)	19.03 (4.32)	15.32 (3.89)	12.41 (3.66)	37.25 (6.09)	24.83 (4.97)
T_4N_2	10.88 (3.44)	16.13 (3.97)	13.50 (3.65)	11.99 (3.60)	34.79 (5.88)	23.39 (4.82)
$CD_{0.05}$	**0.40**	**1.46**	**0.08**	**NS**	**NS**	**NS**

Figures in parentheses are square root transformed values

Table.1c Effect of irrigation, pruning and nitrogen fertilization (I x T x N) interaction of fruit set (%) and fruit yield (kg tree^{-1})

Interaction	Fruit set (%)			Fruit yield (kg tree^{-1})		
	2010-11	2011-12	Pooled	2010-11	2011-12	Pooled
$T_1N_1I_1$	0.00 (1.00)	3.74 (1.92)	1.87 (1.36)	0.00 (1.00)	1.46 (1.20)	0.73 (0.85)
$T_2N_1I_1$	4.18 (2.27)	8.34 (2.88)	6.26 (2.50)	4.20 (2.27)	12.51 (3.53)	8.35 (2.88)
$T_3N_1I_1$	13.26 (3.77)	28.92 (5.37)	21.09 (4.59)	14.59 (3.94)	45.66 (6.75)	30.12 (5.48)
$T_4N_1I_1$	12.42 (3.66)	25.26 (5.01)	18.84 (4.33)	13.34 (3.78)	40.43 (6.35)	26.89 (5.18)
$T_1N_2I_1$	0.00 (1.00)	3.04 (1.74)	1.52 (1.23)	0.00 (1.00)	1.30 (1.14)	0.65 (0.80)
$T_2N_2I_1$	3.00 (2.00)	7.73 (2.78)	5.36 (2.31)	3.58 (2.13)	11.76 (3.42)	7.67 (2.76)
$T_3N_2I_1$	12.96 (3.73)	23.57 (4.83)	18.36 (4.26)	13.32 (3.78)	42.16 (6.49)	27.74 (5.26)
$T_4N_2I_1$	12.01 (3.60)	22.03 (4.69)	17.02 (4.12)	12.98 (3.73)	39.38 (6.27)	26.18 (5.11)
$T_1N_1I_2$	0.00 (1.00)	2.45 (1.56)	1.22 (1.10)	0.00 (1.00)	1.07 (1.03)	0.53 (0.73)
$T_2N_1I_2$	2.84 (1.95)	6.56 (2.56)	4.70 (2.16)	2.90 (1.97)	10.76 (3.28)	6.83 (2.61)
$T_3N_1I_2$	12.81 (3.71)	21.12 (4.59)	16.96 (4.11)	13.12 (3.75)	40.86 (6.39)	26.99 (5.19)
$T_4N_1I_2$	11.52 (3.53)	18.50 (4.30)	15.01 (3.87)	12.45 (3.66)	38.25 (6.18)	25.35 (5.03)
$T_1N_2I_2$	0.00 (1.00)	1.86 (1.36)	0.93 (0.96)	0.00 (1.00)	0.94 (0.97)	0.47 (0.68)
$T_2N_2I_2$	2.30 (1.81)	5.66 (2.38)	3.98 (1.99)	2.71 (1.92)	9.68 (3.11)	6.19 (2.48)
$T_3N_2I_2$	11.64 (3.55)	18.38 (4.28)	15.01 (3.87)	13.03 (3.74)	38.54 (6.20)	25.78 (5.07)
$T_4N_2I_2$	10.21 (3.34)	14.94 (3.86)	12.57 (3.54)	12.23 (3.63)	37.48 (6.12)	24.86 (4.98)
$T_1N_1I_3$	0.00 (1.00)	1.62 (1.27)	0.81 (0.89)	0.00 (11.86)	0.82 (0.90)	0.41 (0.64)
$T_2N_1I_3$	1.50 (1.57)	4.33 (2.08)	2.91 (1.70)	2.48 (3.71)	8.27 (2.87)	25.38 (2.31)
$T_3N_1I_3$	11.60 (3.54)	14.78 (3.84)	13.19 (3.63)	12.82 (3.52)	35.57 (5.96)	24.19 (4.91)
$T_4N_1I_3$	10.87 (3.44)	13.33 (3.65)	12.10 (3.47)	11.43 (3.52)	33.07 (5.75)	22.25 (4.71)
$T_1N_2I_3$	0.00 (1.00)	0.78 (0.87)	0.39 (0.61)	0.00 (1.00)	0.46 (0.67)	0.23 (0.47)
$T_2N_2I_3$	0.98 (1.40)	3.21 (1.79)	2.09 (1.44)	2.12 (1.75)	5.94 (2.43)	4.03 (2.00)
$T_3N_2I_3$	12.26 (3.64)	12.36 (3.50)	12.26 (3.50)	11.93 (3.59)	32.64 (5.71)	22.28 (4.72)
$T_4N_2I_3$	10.42 (3.37)	11.41 (3.37)	10.92 (3.30)	10.75 (3.42)	27.50 (5.24)	19.13 (4.37)
$CD_{0.05}$	**NS**	**NS**	**NS**	**NS**	**0.05**	**0.08**

Figures in parentheses are square root transformed values

The highest yield was observed in lightly pruned trees (HB of Scaffolds 25%) and lowest in heavily pruned trees (HB of Scaffolds 75%) in both the years. The yield reduction in the medium and heavily pruned trees was due to the removal of higher proportion of the fruiting wood by shoot shortening.

Similar increase in yield due to light pruning have also been reported by Kanwar and Nijjar (4), Badiyala and Awasthi (2) and Singh (7). The effect of Fertilizer on fruit set and yield revealed that N_1 treatment gave the highest fruit set and yield and lowest was obtained from N_2 treatment.

Interaction I x N was non significant on the percent fruit set while I x T had significant influenced. This might be due to the collective effects of pruning and irrigation treatments.

I x T and I x N exhibit significant effect on fruit yield while T x N interaction had non significant effect. The increase in yield may be due to cumulative effect of frequent irrigation, pruning N-fertilization.

The present study revealed that highest fruit set and yield was obtained in trees irrigated at 20 per cent soil moisture depletion of field capacity (I_1), T_3 (Heading back of scaffolds 25%) and N_1 (75% additional N as CAN) treatment. The lowest fruit set was recorded in 60 per cent SMD of field capacity irrigation treatments.

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