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Short Communication

Effect of pruning intensity and foliar feeding of nutrients on growth, yield and quality of phalsa (*Grewia subinaeqalis* D.C.)

H. K. Singh, Shashank Singh, Ashish Singh and Bhanu Pratap
Department of Horticulture, A. N. D. University of Agriculture & Technology, Kumarganj
Ayodhya-224 229 (U.P)
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Phalsa also known as star apple is subtropical fruit cultivated commercially in Punjab, Haryana, Uttar Pradesh, and Madhya Pradesh. It is also cultivated in limited scale in the states of Maharashtra, Gujarat, Andhra Pradesh, Bihar and West Bengal. Fruits are eaten fresh and juice is used for making squash and syrup, on other hand wood is used for fuel to rural people and used for basket making which income generating entrepreneurship to the rural formers and poor people. It is quick growing, hardy shrub thrive well in wide range of soils even on salt affected wastelands. Phalsa can also be grown as intercrop in mango, aonla, bael and ber orchards. Little information is available on pruning combined with foliar feeding of phalsa for better plant health and higher production of quality fruits which has good medicinal properties known since Vedic times.

Field experiment was conducted at main experiment station (Horticulture) N. D. U. A. & T., Kumarganj, Ayodhya (U P). Forty five plants of eighteen years old phalsa cv. Sharbati, uniform in size and vigour planted at distance at 3x2 m were selected. The experiment was laid out in Factorial R B D with three replications having 15 treatment combination including 3 levels of pruning *viz.*, pruned at 25 cm, 50 cm and 75 cm above ground level and 5 chemical treatment *viz.*, control (water) $ZnSO_4$ 0.4%, $CuSO_4$ 0.4% , K_2SO_4 0.2% and Urea 2% solution.

Pruning of phalsa bushes was done in first week of February and spray of nutrients solution was done in 2nd fourth night of March (pre 100 m stage) while second spray was done after fruit setting. Observation were recorded on number of shoot/fruiting nodes/shoot, fruits /node, fruits yield/plant, weight of 50- fruits, juice percent and quality of juice in terms of TSS, acidity ascorbic acid and sugar contents per methods given in A.O.A.C (1996).

Perusal of data presented in Table 1 revealed that shoot per plant fruiting node per shoot fruits/node and fruit yield was influenced significantly by node. Pruning intensity and flower foliar feeding of nutrients influenced all yield characters significantly. The highest numbers of shoots (300), nodes/shoot (18.08), and fruit number per node were recorded with pruning 50 cm above ground level. Same level of pruning and foliar feeding of $ZnSO_4$ 0.4% for followed by Urea 2.0%. The increase in growth parameters in might be due to the fact that potash, zinc and Cu activate many enzymes required for photosynthesis and play role in metabolism and same time spray of urea is constituent of protein essential for formation of protoplasm, influence cell division, elongation and causes better plant growth. The finding is in line with the findings in litchi (Kumar *et al.*, 2004) phalsa (Pankaj *et al.*, 2004; Rathore, 2010)

It is also clear from the data (Table 2) that response of pruning and nutrients also increased fruit yield being highest (4.10 kg/plant) with pruning 50 cm above ground level combined with $ZnSO_4$ 0.4% foliar feeding follow by same level of pruning follow by spray of Uera 2.0%. Similar were the finding of Tiwari *et al.* (2011) in aonla and Mishra and Pathak (1998) in Guava.

A perusal of data presented in Table 2 that weight of 50 fruit and juice per cent were influence by pruning intensity and feeding of nutrients. The highest 50 fruits was recorded (47.67 g) pruning at 50 cm above ground level with $ZnSO_4$ 0.4% followed by same level of pruning sprayed with 2.0% urea foliar feeding followed by K_2SO_4 0.2% foliar feeding (49.67) and pruning at 50 cm above ground level. The present findings are in close agreement with Arora and Yamdagni (1985) in fruiting of sweet lime, Singh and Singh (2008) in cv. NA-7 and Singh *et al.* (2001) in aonla cv. Francis. The juice content was increased due to fact that nutrients (N, K, Zn and Cu) application result in more up take of nutrients in plant and absorption of more water with minerals because of increase turgor pressure resulting increase in juice content. The present findings are in also agreement with Kumar (2004) in litchi.

Pruning intensity and foliar feeding of nutrients influenced the TSS, acidity and ascorbic acid content in juice (Table 2 and 3) and chemical. The interaction effect between pruning levels and chemicals on TSS was found significant and noted highest (28.40) with combined effect of $ZnSO_4$ 0.4% along with pruning at 50 cm above ground level and effect was significant than rest of the combination. The increase in TSS content may be explained by the fact that applied nutrients are helpful to photosynthesis which ultimately led to the accumulation of carbohydrate which helps to increase TSS content of juice. The acid content in

juice decreased significantly with foliar feeding, while non significant effect was observed with pruning levels. The reason for decreased in acidity due to nutrients (N, K, Zn and Cu) might be due to increase translocation of carbohydrates due to conversion of acid to sugar. The finding is in agreement to Joon *et al.,* (1984). The highest ascorbic acid content (37.28 mg /100g juice) was recorded with combined effect of $ZnSO_4$ 0.4% closely followed by spray of K_2SO_4 0.2% (36.63 mg/100 g juice) along with pruning at 50 cm above ground level. Similar response has also been reported by Singh *et al.,* (2009) in aonla and Singh *et al.,* (1995) in ber. The increase in ascorbic acid content may be attributed to quality improving properties of N, K, Zn and Cu. The increase in ascorbic acid content in potassium treated fruits might be due to the stimulated function of enzymes which participate in the synthesis of ascorbic acid. The reducing sugars, non reducing sugars and total sugars in fruits juice of phalsa have also been increased as influenced by pruning levels and spray of nutrients (Table 3).

The highest level of reducing sugars (13.76), non reducing sugar (3.77%) and total sugars (17.53) were found with foliar spray of $ZnSO_4$ (0.4%) closely followed by K_2SO_4 (0.2%) along with pruning at 50 cm above ground level. The significant increase in sugar contents might be due to accumulation of carbohydrates in fruits as a result of N, K, Zn and Cu application and also the role played by regular pruning of phalsa as phalsa needs regular pruning of previous season shoots. Similar finding are also reported, Singh *et al.,* (1979) in grapes, and Bhatia and Yadav (2005) in ber. It can be concluded that pruning of phalsa at 50 cm above ground level combined with $ZnSO_4$ (0.4%) increased number of shoot, and fruiting nodes closely followed by urea 2% and K_2SO_4 (0.2%) with pruning at 50 cm above ground level. Better response was obtained with fruit yield attributing attributes. The fruit quality in terms of TSS, acidity, ascorbic acid content, juice

Table 1. Effect of pruning intensity and foliar feeding of nutrients on vegetative and yield attributes of phalsa

Treatments	Number of shoots per plant				Number of fruiting nodes per shoots				Number of fruits per nodes				Fruit yield (kg/plant)			
	Pruning (Above ground level)			Mean	Pruning (Above ground level)			Mean	Pruning (Above ground level)			Mean	Pruning (Above ground level)			Mean
	25 cm (P_2)	50 cm (P_2)	75 cm (P_3)		25 cm (P_1)	50 cm (P_2)	75 cm (P_3)			50 cm (P_2)	75 cm (P_3)		25 cm (P_1)	50 cm (P_2)	75 cm (P_3)	
Control (C_0)	22.67	26.67	21.00	23.44	15.67	16.40	14.67	15.58	14.00	14.70	14.33	14.34	2.84	3.10	2.83	2.92
$ZnSO_4$ 0.4% (C_1)	32.00	33.33	31.33	32.22	18.67	19.80	18.33	18.93	16.33	17.15	16.00	16.49	3.70	4.10	3.67	3.82
$CuSO_4$ 0.4% (C_2)	29.00	29.67	28.67	29.11	17.00	17.60	16.67	17.09	15.33	16.10	15.00	15.48	3.60	3.95	3.63	3.73
K_2SO_4 0.4% (C_3)	30.00	30.33	29.67	30.00	16.67	18.00	17.33	17.33	15.67	16.40	14.67	15.58	3.56	3.90	3.79	3.81
Urea 2.0% (C_4)	32.67	33.00	30.67	32.11	17.67	18.60	16.00	17.42	16.33	17.10	15.00	16.14	3.68	4.05	3.71	
Mean	29.27	30.60	28.27		17.14	18.08	16.60		1553	16.29	15.00		3.48	3.82	3.53	
	P	C	PxC		P	C	PxC		P	C	PxC		P	C	PxC	
SEm±	0.40	0.51	0.89		0.31	0.40	0.70		0.28	0.37	0.63		0.07	0.08	0.15	
CD at 5%	1.15	1.48	NS		0.90	1.17	2.02		0.82	1.06	1.84		0.19	0.25	0.43	

Table 2. Effect of pruning intensity and foliar feeding of nutrients on fruit quality attributes of phalsa

Treatments	Weight of 50 fruits (g)				Juice content (%)				TSS (° Brix)				Acidity (%)			
	Pruning (Above ground level)			Mean	Pruning (Above ground level)			Mean	Pruning (Above ground level)			Mean	Pruning (Above ground level)			Mean
	25 cm (P_1)	50 cm (P_2)	75 cm (P_3)		25 cm (P_1)	50 cm (P_2)	75 cm (P_3)		25 cm (P_1)	50 cm (P_2)	75 cm (P_3)		25 cm (P_1)	50 cm (P_2)	75 cm (P_3)	
Control (C_0)	42.67	43.00	42.33	42.67	37.00	37.00	36.33	36.78	19.22	21.23	18.38	19.61	2.35	2.20	2.30	2.28
$ZnSO_4$ 0.4% (C_1)	47.00	47.67	42.00	45.56	47.67	48.67	44.67	47.00	27.65	28.40	26.76	27.87	1.83	1.80	1.88	1.84
$CuSO_4$ 0.4% (C_2)	40.33	42.00	41.00	41.11	46.67	50.33	43.33	46.78	26.12	26.34	25.16	25.87	2.25	2.32	2.27	2.28
K_2SO_4 0.4% (C_3)	43.00	44.33	41.33	42.89	50.00	51.00	48.00	49.67	26.91	27.62	25.82	26.78	1.96	2.02	2.05	2.01
Urea 2.0% (C_4)	43.33	44.00	43.00	43.44	49.33	52.00	49.00	50.11	26.13	27.13	25.87	26.38	2.22	2.13	2.35	2.23
Mean	29.27	30.60	28.27		46.13	47.80	44.27		25.20	26.15	24.40		2.12	2.09	2.17	
	P	C	PxC		P	C	PxC		P	C	PxC		P	C	PxC	
SEm±	0.27	0.35	0.61		0.47	0.61	1.05		0.19	0.25	0.43		0.03	0.04	0.06	
CD at 5%	0.79	1.01	1.76		1.36	1.76	3.04		0.56	0.72	1.25		NS	0.10	NS	

Table 3. Effect of pruning intensity and foliar feeding of nutrients on ascorbic acid and sugar content of phalsa fruits

Treatments	Ascorbic acid (mg/100g pulp)				Reducing sugar (%)				Non reducing sugar (%)				Total sugar (%)			
	Pruning (Above ground level)			Mean	Pruning (Above ground level)			Mean	Pruning (Above ground level)			Mean	Pruning (Above ground level)			Mean
	25 cm (P_1)	50 cm (P_2)	75 cm (P_3)		25 cm (P_1)	50 cm (P_2)	75 cm (P_3)		25 cm (P_1)	50 cm (P_2)	75 cm (P_3)		25 cm (P_1)	50 cm (P_2)	75 cm (P_3)	
Control (water) C_0	27.03	27.81	26.65	27.16	11.52	11.93	10.57	11.52	3.16	3.27	2.9	3.11	14.68	15.2	13.47	14.45
$ZnSO_4$ 0.4% (C_1)	36.5	37.28	35.98	36.59	13.29	13.76	13.25	13.29	3.65	3.77	3.63	3.69	16.94	17.53	16.88	17.12
$CuSO_4$ 0.4%(C_2)	34.86	35.58	33.97	34.8	12.88	13.07	12.48	12.88	3.53	3.58	3.42	3.51	16.42	16.65	15.9	16.32
K_2SO 0.4% (C_3)	35.9	36.63	35.05	35.86	12.92	13.13	12.73	12.92	3.54	3.6	3.49	3.55	16.46	16.73	16.22	16.47
Urea 2.0% (C_4)	35.21	35.91	34.86	35.32	12.8	12.87	12.86	12.8	3.51	3.53	3.53	3.52	16.32	16.4	16.38	16.37
Mean	33.9	34.64	33.3		12.68	12.95	12.37	12.68	3.48	3.55	3.4		16.16	16.5	15.77	
	P	C	PxC		P	C	PxC		P	C	PxC		P	C	PxC	
SEm±	0.22	0.29	0.49		0.15	0.19	0.33		0.04	0.05	0.09		0.19	0.25	0.43	
CD at 5%	0.64	0.83	NS		0.43	0.56	NS		0.12	0.15	NS		0.56	0.71	1.25	

per cent and sugar contents were better with $ZnSO_4$ (0.4%) combined with pruning at 50 cm above ground level closely followed by K_2SO_4 (0.2%) with pruning at 50 cm above ground level.

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