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Studies on the effect of pruning, GA₃ and NAA on plant growth, flowering, fruit yield and economics of Phalsa (*Grewia asiatica* L.) in Allahabad region

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Abstract

The present investigation was carried out under Allahabad agro-climatic conditions at the experimental field of the department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad (U.P.) entitled “Studies on the effect of pruning, GA₃ and NAA on plant growth, flowering, fruit yield and economics of Phalsa (*Grewia asiatica* L.) in Allahabad region.” The pruning (30 cm, 60 cm and 90 cm) was done from old shoots of phalsa plant with the help of looper by manual labour and PGRs namely NAA (150 and 200 ppm) and GA₃ (100 and 200 ppm) were applied as foliar spray after new shoots growth. The results revealed that treatment T₆ showed the maximum number of canes per bush (13.67), number of sprouted shoots per cane (27.40), length of shoots per cane (84.64 cm), number of leaves per shoot (23.46), total number of flowers per plant (2927.41) at 75 days after pruning, fruit yield per bush (4.78 kg), fruit yield per hectare (6.94 t/ha), total soluble solids (22.82°Brix), total sugar (12.33%), and Benefit cost ratio (1:3.75), the minimum days to sprouting of shoots (36.53) and days taken to first flower (61.24). The minimum number of canes per bush (5.34), number of sprouted shoots per cane (13.09), length of shoots per cane (55.67cm), number of leaves per shoot (17.50), total number of flowers per plant (1633.34) at 75 days after pruning, fruit yield per bush (1.45 kg), fruit yield per hectare (2.06 t/ha), total soluble solids (TSS) (15.37°Brix), total sugar (8.36%), and Benefit cost ratio (1:1.15), the maximum days to sprouting of shoots (46.55) and days taken to first flower (75.37) were recorded with treatment T₀.

Keywords: bush, GA₃, fruit yield, NAA, and pruning levels

Introduction

Phalsa (*Grewia asiatica* L.) is Indian originated fruit crop with belongs to family of tiliaceae and also known as star apple. It is a sub-tropical crop but it is good for arid and semi – arid regions because it's hardy nature and capacity to tolerate high temperature and even grown under prolonged dry spell with little care. It is commercially grown in Uttar Pradesh, Punjab, Haryana, Gujarat, Maharashtra and Bihar. Its cultivation is favoured around big cities where fruits find a read and quick sale and regarding keeping quality and it is highly perishable in nature and suitable for as an intercrop with mango, Aonla, Bael and ber orchard. Phalsa is a bushy plant and can be grown in kitchen garden also.

It is deciduous in habit in northern India and sheds its leaves during winter season, which makes capable of withstanding to the frost. It produces fruits in clusters in the axils of leaves of the young shoots. It is one of the hardiest fruit crop with regard to the attack of insect pests and diseases. It can tolerate up to 44 °C high temperature which favours in ripening of the fruits and start fruiting after second year of its plantation and thus the growers can obtained much income returns.

Pruning and plant growth regulators (PGR's) have been commonly used in modifying various physiological processes with advantage in vegetative growth, flowering, fruit yield and also quality parameters in phalsa. The plant should be pruned annually at 90-100 cm from the ground level to obtain more yields of good quality fruits reported by Shanker (1987).

Application of growth substances viz., auxins and gibberellins has been effective in increasing fruit set and yield in several fruit crops including phalsa. Application of GA₃ results in increased yield and better grade phalsa fruits (Rema and Sharma, 1991) [9].

Materials and Methods

The present investigation was carried out under Allahabad agro-climatic conditions at the experimental field of the department of Horticulture, Naini Agricultural Institute, Sam

Higginbottom University of Agriculture Technology & Sciences, Allahabad (U.P.). The pruning was done with the help of lopper by manual labour. Prior to start the pruning, only 8-12 canes were selected from each bush for the observation. The experiment was laid out in Randomized Block Design (RBD) with 13 treatments and each treatment replicated thrice, thus making a total 39 plants. The allocation of treatment to the individual plots was done using random number in each replication.

The various combination of pruning (cm) and different plant growth regulators were as: T₀-Control (water control), T₁-(30 cm + GA₃ @ 100 ppm + NAA @ 150 ppm), T₂-(30 cm + GA₃ @ 200 ppm + NAA @ 200 ppm), T₃-(60 cm + GA₃ @ 100 ppm + NAA @ 150 ppm), T₄ - (60 cm + GA₃ @ 200 ppm + NAA @ 200 ppm), T₅ -(90 cm + GA₃ @ 100 ppm + NAA @ 150 ppm), T₆ -(90 cm + GA₃ @ 200 ppm + NAA @ 200 ppm), T₇-(30 cm + GA₃ @ 100 ppm + NAA @ 200 ppm), T₈ - (30 cm + GA₃ @ 200 ppm + NAA @ 150 ppm), T₉-(60 cm + GA₃ @ 100 ppm + NAA @ 200 ppm) T₁₀ - (60 cm + GA₃ @ 200 ppm + NAA @ 150 ppm), T₁₁-(90 cm + GA₃ @ 100 ppm + NAA @ 200 ppm) and T₁₂-(90 cm + GA₃ @ 200 ppm + NAA @ 150 ppm).

The following observations were recorded the number of canes per bush, days to sprouting of shoots, number of sprouted shoots per cane, length of shoots per cane (cm), number of leaves per shoot, days taken to first flower, total number of flowers per plant at 75 days after pruning, fruit yield per bush, yield per hectare, total soluble solids (TSS) °Brix, total sugar (%) and Benefit cost ratio.

Results and Discussion

The number of canes per bush as influence by different pruning levels and plant growth regulators are presented in it is evident from the table. The maximum number of canes per bush (13.67) was observed with treatment T₆ (90 cm + GA₃@200ppm + NAA@200ppm) followed by treatment T₁₁ (90 cm + GA₃@100ppm + NAA@200ppm) (12.60) and the minimum number of canes per bush was noticed in treatment T₀ (5.34). The pruning level at 90 cm (P₄) had significantly the maximum number of canes (13.66) and number of sprouted shoots/cane (29.29) reported by Abid *et al.* (2012)^[1]. Similar results were also reported by Rawat *et al.* (1998)^[8].

The data on the days to sprouting of shoots after pruning as influenced by different growth regulator are presented in table. The T₆ (90 cm + GA₃ @ 200 ppm + NAA @ 200 ppm) took significant less days to sprouting (36.53) followed by T₈ (30 cm + GA₃ @ 200 ppm + NAA @ 150 ppm) (39.67). The maximum days to sprouting of shoots was noticed in treatment T₀ (46.55). The number of sprouted shoots per cane at 100 DAP is clear that the treatment T₆ (90 cm + GA₃ @ 200 ppm + NAA @ 200 ppm) was recorded significantly the maximum number of sprouted shoots per canes (27.40) closely followed by T₁₁ (90 cm + GA₃ @ 100 ppm + NAA @ 200 ppm) (25.21) and minimum number of sprouted shoots

per canes recorded with treatment T₀ (13.09). Similar results were also reported by Chaturvedi and Ram (2014)^[2].

The length of shoots per cane (cm) at 100 (days after pruning (DAP) is clear that the treatment T₆ was recorded significantly the maximum length of shoots per canes (84.64 cm) closely followed by T₁₂ (78.35). The minimum length of shoots per canes with treatment T₀ (55.67). Similar results were also reported by Kacha *et al.* (2012) and Singh *et al.* (2006)^[5, 14].

The number of leaves per shoot at 100 DAP is clear that the treatment T₆ recorded significantly by maximum number of leaves per shoots of phalsa (23.46) closely followed treatment T₅ while the minimum number of leaves per shoots was recorded with treatment T₀ (17.50). The GA₃ at 50 ppm increased number of leaves and the maximum longer shoots were produced under foliar application of 60 ppm GA₃ reported by Singh *et al.* (2011)^[6].

The less number of days first flowers were observed (61.24) with T₆ followed by T₅ (62.37) and the maximum number of days taken to first flowering was observed in treatment T₀ (75.37). Similar results were also reported by Singh and Singh (2003)^[12].

The maximum total number of flowers per plant (2927.41) was obtained with T₆ which were significantly superior over other treatments followed by T₁₁ (2776.65) and the minimum total number of flowering per plant (1633.34) was noticed with treatment T₀. Similar results were also reported by Singh *et al.* (2004) and Kacha *et al.* (2014)^[4, 13].

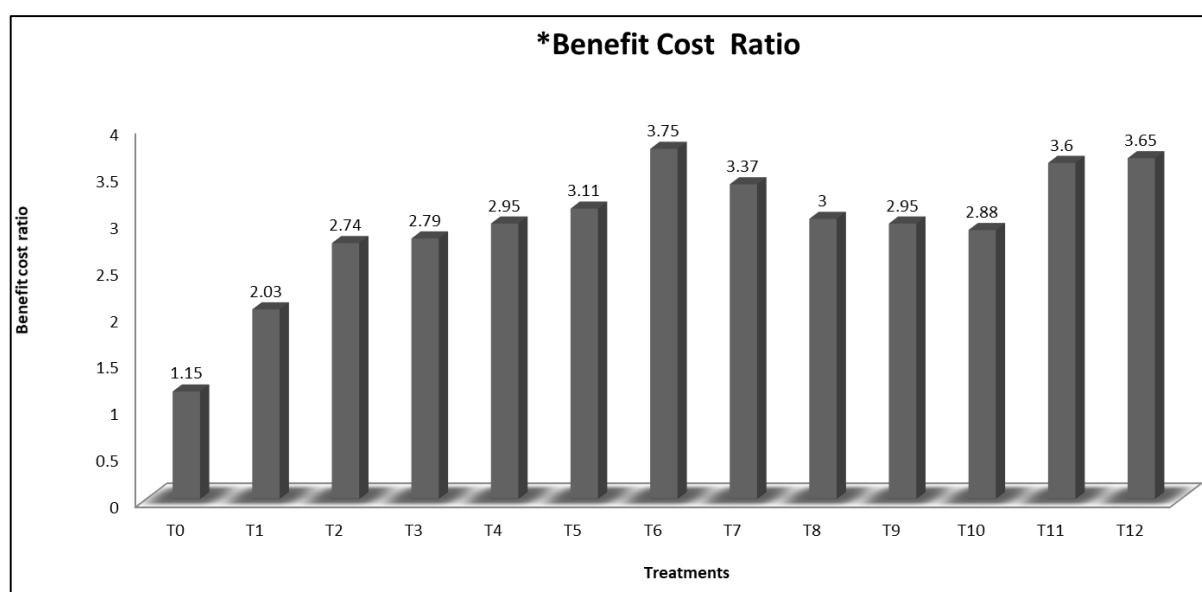
It is a clear from the table that fruit yield per bush was significantly influenced by different treatments and the treatment T₆ was recorded the maximum number of fruits per bush (4.78 kg) followed by T₅ (4.71 kg). The fruit yield was significantly influenced by different treatments. Treatment T₆ was given the highest fruit yield (6.94 t/ha) followed by T₁₂ (6.75 t/ha) while the minimum fruit yield was noticed with control (2.06 t/ha). Similar results were also reported by Rathore *et al.* (2008), Jamil *et al.*, (2006) and Rema and Sharma (1993)^[7, 3, 10].

TSS °Brix was significantly influenced by different treatment T₆ was recorded the maximum number of fruits per bush (22.82 °Brix) followed by T₁₁ (21.49°Brix). The minimum T.S.S. was noticed with control (15.37°Brix). Similar results were also reported by Singh *et al.* (2011)^[6]. The highest total sugar was observed with treatment T₆ (12.33%) followed by T₁₁ (11.72%) while the minimum total sugar was noticed with treatment T₀ (8.36). Similar results were also reported by Kacha *et al.* (2012)^[5].

The highest economical performances were showed with treatment T₆ in terms of the gross return (208200 Rs/ha) followed by Treatment T₁₂ (202650 Rs/ha), net return (152700 Rs/ha) cultivation (55500 Rs/ha) followed by (147150 Rs/ha) and benefit cost ratio 3.75 while minimum benefit cost ratio was recorded with treatment T₀ (1.15). Similar findings were also reported by Kumar *et al.* (2011) and Rathore *et al.* (2008)^[15, 7].

Table 1: Studies on the effect of pruning, GA₃ and NAA on growth, flowering, fruit yield and economics of Phalsa in Allahabad region

Treatments No.	Number of canes per bush	Days of sprouting g shoots	Number of sprouted shoots per canes (100 DAP)	length of shoots/ cane (cm) 100 DAP	Number of leaves per shoots	Days taken to first flowering	Total number of flowers per plant	Fruit Yield per bush (Kg)	Fruit yield (t/ha)	TSS (°Brix)	Total sugar (%)	Benefit Cost Ratio
T ₀	5.34	46.55	13.09	55.67	17.50	75.37	1633.34	1.45	2.06	15.37	8.36	1.15
T ₁	10.13	42.24	22.34	70.50	18.76	63.41	2310.34	3.25	3.76	17.27	8.41	2.03
T ₂	11.20	44.44	21.33	73.48	19.55	63.38	2133.54	3.35	5.06	19.15	10.86	2.74
T ₃	10.36	42.44	21.42	75.46	20.47	65.64	2090.48	3.33	5.15	17.59	10.58	2.79
T ₄	11.31	41.40	22.32	77.59	19.46	67.39	2420.54	3.50	5.45	16.32	9.29	2.95
T ₅	12.36	40.31	23.75	78.44	22.84	62.37	2760.41	4.71	5.74	21.33	9.41	3.11
T ₆	13.67	36.53	27.40	84.64	23.46	61.24	2927.41	4.78	6.94	22.82	12.33	3.75
T ₇	9.37	42.23	19.23	67.78	19.41	65.20	1932.54	3.70	6.23	19.67	10.59	3.37
T ₈	10.69	39.67	19.87	60.52	17.48	63.31	2064.65	3.66	5.55	18.60	11.49	3
T ₉	11.17	38.69	22.62	68.52	22.36	64.52	2449.41	3.58	5.45	17.65	10.57	2.95
T ₁₀	10.98	43.40	23.11	66.89	20.30	62.38	2365.41	3.81	5.33	17.38	10.38	2.88
T ₁₁	12.60	44.48	25.21	76.43	22.60	63.60	2776.65	4.18	6.65	21.49	11.72	3.6
T ₁₂	12.33	42.59	22.55	78.35	22.53	66.75	2733.65	4.30	6.75	21.43	9.69	3.65
C.D. at 0.5%	0.55	0.31	0.59	0.33	1.61	0.22	0.12	0.25	0.36	0.33	0.32	-

**Fig 1:** Studies on the effect of pruning, GA₃ and NAA on growth, flowering, fruit yield and economics of Phalsa in Allahabad region

Conclusion

The present investigation was carried out under Allahabad agro-climatic conditions at the experimental field of the department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology & Sciences, Allahabad (U.P.). It was concluded that the best performances in terms of plant growth, flowering, yield, quality and economics of phalsa were recorded with the treatment T₆ (90 cm + GA₃ @ 200 ppm + NAA @ 200 ppm).

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