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Optimizing phalsa (cv. Local) growth, flowering, and yield parameters through round-the-year pruning and fertilizer management

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Abstract

An experiment was conducted to study the effect of round-the-year pruning and fertilizer doses on phalsa's growth, flowering and yield parameters during 2020-21 and 2021-22 at Horticulture Research Farm, Anand Agricultural University, Anand. The experiment was laid out in a completely randomized design (Factorial) with two factors, eighteen treatment combinations, and three repetitions. The first factor was pruning time (1st week of January (Control), 1st week of March, 1st week of May, 1st week of July, 1st week of September and 1st week of November) and the second factor was fertilizer doses (100:50:50 g NPK/plant (Control), 200:75:75 g NPK/plant, 300:100:100 g NPK/plant). The results revealed that pruning in 1st week of May recorded minimum days for sprouting new shoots after pruning. Pruning in 1st week of March resulted in the maximum number of sprouted shoots per cane, length of the shoot at harvest, weight of fruit per plant, fruit yield and minimum days taken for flowering, fruit set and first picking after pruning. A fertilizer dose of 300:100:100 g NPK/plant recorded minimum days for sprouting of new shoots, maximum number of sprouted shoots per cane and length of shoot at harvest. The shortest duration for flowering, fruit set, and initial harvest was observed using a fertilizer dose of 100:50:50 g NPK per plant (Control). The application of 200:75:75 g NPK per plant was most effective for maximum fruit weight and overall yield of phalsa. Furthermore, this fertiliser dose significantly boosted phalsa yields when combined with pruning during the first week of March.

Key words: Round-the-year pruning, fertilizer, growth, flowering, yield, pruning time, new shoots, days taken for flowering, first picking

Introduction

Phalsa, belonging to the genus *Grewia* of the family Malvaceae, is a native fruit of India and is now widely cultivated in arid parts of tropical and subtropical regions. Commercial cultivation of phalsa is practiced in Punjab, Haryana, Rajasthan, Uttar Pradesh and Madhya Pradesh. Apart from these states, it is also grown on a small scale in Gujarat, Bihar, Maharashtra, Andhra Pradesh and West Bengal. It is widely grown for its sweet and sour acidic fruit, sold on the market throughout summer. Fruits include 10-11 % sugar, 2.0-2.5 % acid and 50-60 % juice.

Pruning is an important practice for phalsa; optimum pruning height gives a good crop. Phalsa bears fruit on the current season's growth and frequent annual pruning is required for good yield by cutting the old growth and enhancing the new growth. Plants can be pruned during December or January when they are dormant. The phalsa plants pruned 100 cm from ground level during late winter result in more vegetative growth and high yield (Aziz *et al.,* 2018).

As phalsa is a heavy feeder crop, nutrition given to it shows a significant effect on the various growth flowering and fruit set parameters (Hayes, 1957). The crop is borne on new growth, and applying fertilizers and manures will encourage vegetative growth, resulting in better fruit yield. Plant nutrition management has a stronger influence on flowering, fruit set, fruit size, the amount of vegetative growth, and other plant traits. N influences fruit development, yield, and quality more than P and K. Lower nitrogen doses lead to lower vegetative growth and yield, whereas too high dose of N results in fruit mortality (Bindra and Chauhan 1974). Phosphorus and potassium application increases the amount of sugars in the fruits.

Generally, the phalsa plant is pruned in winter (December-January) to get the yield in summer (April-May). Although, pruning in different months can give yield in summer, rainy and winter season. Pruning throughout the year in phalsa can produce fruit in the off-season, which may fetch a higher price on the market, and farmers might harvest two to three crops each year, so increasing their income. Application of fertilizers play an important role in phalsa's growth, flowering, yield, and quality. The phalsa's fertilizer dose varies according to the soil types, environment and climate. At present, there is an ad hoc dose of fertilizers in phalsa. So, this experiment was conducted to study the effect of round-the-year pruning and fertilizer doses on phalsa growth, flowering and yield parameters.

Material and methods

The present investigation was carried out at Horticulture Research farm, Anand Agricultural University, Anand in the years 2020-21 and 2021-22 at two years old phalsa plants having uniform vigour. The soil of the experiment field is loamy sand with soil pH (7.30), available N (233.35 kg/ha), available P (42.57 kg/ha) and Available K (265.45 kg/ha). The experiment was laid out in

a completely randomized design (Factorial) with two factors, eighteen treatment combinations, and three repetitions. First factor was pruning time (P_1= 1st week of January (Control), P_2= 1st week of March, P_3= 1st week of May, P_4= 1st week of July, P_5= 1st week of September and P_6= 1st week of November) and second factor was fertilizer doses (F_1= 100:50:50 g NPK/plant (Control), F_2= 200:75:75 g NPK/plant, F_3= 300:100:100 g NPK/plant).

Phalsa plants were pruned out at first week of particular month at height of 1 m from ground level as per the treatments with the help of sharp secateurs. Well prepared vermicompost @ 5 kg per plant and chemical fertilizers were applied as per the treatments at the time of pruning. Nitrogen was applied in the form of urea and diammonium phosphate (DAP), phosphorous was applied in the form of diammonium phosphate (DAP) and potassium was applied in the form of muriate of potash (MOP). The manures and fertilizers were applied in rings around the plants and were mixed into the soil.

Variables recorded included days to sprouting new shoots after pruning, sprouted shoots per cane, shoot length at harvest (cm), days to flowering/fruit set/first picking after pruning, fruit weight per plant (kg), and yield (kg/ha).

Result and discussion

Growth parameters: The data regarding effect of round the year pruning and fertilizer doses on growth parameters of phalsa are presented in Table 1. There was a significant difference among treatments for days to sprouting new shoots, number of sprouted shoots per cane and length of shoot at harvest. Pruning time P_3 (1st week of May) recorded significantly minimum number of days to sprouting of new shoots after pruning (6.33 and 6.11) in the years 2020-21 and 2021-22 which was at par with P_4 (1st week of July) in both the years. The significantly maximum number of sprouted shoots per cane (16.37 and 17.20) was found in pruning time P_1 [1st week of January (Control)] in the years 2020-21 and 2021-22 which was found at par with P_2 (1st week of March) in the year 2021-22. The highest length of shoot at harvest (139.56 and 139.64 cm) was recorded with pruning time P_1 [1st week of January (Control)] in the years 2020-21 and 2021-22 which was found at par with pruning time P_2 (1st week of March) in both the years. Due to the optimal environmental conditions, *i.e.*, high temperature and optimal humidity for the plant, summer pruning resulted in more plant growth than winter pruning. During the growth phase, plants grow more rapidly when temperatures are relatively high (Khodorova and Boitel-Conti 2013). These findings are in accordance with Aziz *et al.* (2018) and Mahida *et al.* (2022) in phalsa and Kumar *et al.* (2014a) in ber.

Among the fertilizer doses treatments, treatment F_3 (300:100:100 g NPK/plant) registered significantly minimum number of days to sprouting of new shoots after pruning (7.00 and 6.89), maximum number of sprouted shoots per cane (17.36 and 16.62) and highest length of shoot at harvest (134.47 and 134.42 cm) in both the years 2020-21 and 2021-22. The application of nitrogen enhances the production of the necessary protoplasm and amino acids required for the building of plant tissue and plant proteins (Chu 2021), whereas phosphorous enhance cell division and cell elongation (Kavanova *et al.,* 2006) which directly influences the growth of the plant. Similar observations were also made by Saravanan *et al.* (2013), Gill *et al.* (2015), Gochar *et al.* (2017), Ahmad *et al.* (2019) and Fareed *et al.* (2021) in phalsa.

Table 1. Effect of round the year pruning and fertilizer doses on growth parameters of phalsa

Treatment	Days to sprouting new shoots		No. of sprouted shoot per cane		Length of shoot at harvest (cm)	
	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22
Pruning time						
P_1	9.22	8.56	16.37	17.20	139.56	139.64
P_2	7.11	7.56	14.27	16.06	138.87	137.39
P_3	6.33	6.11	14.08	13.77	125.13	125.86
P_4	6.67	6.78	12.49	12.69	123.97	124.16
P_5	7.44	7.78	11.59	10.23	122.09	119.78
P_6	11.00	9.89	13.32	12.42	102.81	102.86
SE(m)±	0.26	0.26	0.53	0.42	0.92	1.12
CD at 5 %	0.76	0.74	1.51	1.19	2.64	3.22
Fertilizer doses						
F_1	8.94	8.72	10.46	10.93	115.66	113.76
F_2	7.94	7.72	13.24	13.64	126.08	126.67
F_3	7.00	6.89	17.36	16.62	134.47	134.42
SE(m)±	0.19	0.18	0.37	0.29	0.65	0.79
CD at 5 %	0.54	0.52	1.07	0.84	1.87	2.28

Flowering parameters: The data regarding effect of round the year pruning and fertilizer doses on flowering parameters of phalsa are presented in Table 2. The pruning time and fertilizer doses treatments had a significant effect on days taken to flowering after pruning, days taken to fruit set after pruning and days taken to first picking after pruning in phalsa. The treatment pruning in 1st week of March (P_2) recorded significantly minimum number of days taken to flowering after pruning (31.11 and 32.11), days taken to fruit set after pruning (55.56 and 56.44) and days taken to first picking after pruning (90.44 and 91.67) in the both years of 2020-21 and 2021-22. With reference to data, it was observed that pruning in summer season recorded minimum number of days taken to flowering after pruning, days taken to fruit set after pruning and days taken to first picking after pruning while these parameters recorded maximum number of days in winter pruning. Early vegetative growth in summer season pruned plants as well as ideal climatic conditions such as high temperature and optimal humidity resulted in the early flowering in summer season. This early flowering resulted in early fruit set and early picking in summer season in phalsa. Similar results were found by Aziz *et al.* (2018) and Mahida *et al.* (2022) in phalsa, Sharif *et al.* (2018) in ber and Widyastuti *et al.* (2019) in guava.

In terms of treatment fertilizer doses, treatment F_1 [100:50:50 g NPK/plant (Control)] registered significantly minimum number of days taken to flowering after pruning (37.11 and 36.39), days taken to fruit set after pruning (64.28 and 63.33) and days taken to first picking after pruning (99.50 and 100.78) in the both years of 2020-21 and 2021-22. It has been observed that increasing nitrogen doses caused a delay in flowering, which in turn delayed fruit set and the first picking of phalsa. Higher nitrogen levels resulted in a low C: N ratio, which encouraged more vegetative growth and delayed reproductive growth in plants. Similar results were found by Kumar *et al.* (2014b), Gill *et al.* (2015) and Gocher *et al.* (2017) and in phalsa.

Yield parameters: The data regarding effect of round the year pruning and fertilizer doses on yield parameters of phalsa are presented in Table 3. There was a significant difference among treatments for weight of fruit per plant and fruit yield. The study found that the treatment involving pruning in the first week of

Table 2. Effect of round the year pruning and fertilizer doses on flowering parameters of phalsa

Treatment	Days taken to flowering		Days taken to fruit set		Days taken to first picking	
	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22
Pruning time						
P_1	37.33	37.44	65.56	64.78	95.00	95.11
P_2	31.11	32.11	55.56	56.44	90.44	91.67
P_3	35.00	34.33	58.56	58.22	101.33	103.78
P_4	42.78	42.11	72.78	72.11	107.56	107.00
P_5	42.33	41.44	70.44	69.67	106.56	108.89
P_6	45.44	44.33	76.56	75.11	109.44	108.78
SE(m)±	0.26	0.25	0.20	0.24	0.19	0.31
CD at 5 %	0.76	0.72	0.58	0.68	0.55	0.90
Fertilizer doses						
F_1	37.11	36.39	64.28	63.33	99.50	100.78
F_2	39.06	38.94	66.56	66.06	101.67	102.44
F_3	40.83	40.56	68.89	68.78	104.00	104.39
SE(m)±	0.19	0.18	0.14	0.17	0.14	0.22
CD at 5 %	0.54	0.51	0.41	0.48	0.39	0.64

March (P_2) resulted in significantly higher fruit weight per plant (1.777 and 1.902 kg) and fruit yield (1974.25 and 2113.62 kg/ha) compared to other treatments in both 2020-21 and 2021-22. An increase in fruit weight per plant may be attributable to favourable growing conditions, increased vegetative growth, and better fruit growth during summer. The higher number of sprouting shoots per cane during summer also contributes to the higher yield. A decrease in productivity during the rainy season was mostly the result of high fruit drop owing to heavy rainfall. The study found that pruning phalsa plants throughout the year resulted in a consistent fruit yield year-round. This is consistent with previous studies on phalsa by Aziz *et al.* (2018) and Mahida *et al.* (2022), as well as a study on ber by Shukla *et al.* (2007).

The study found that treatment F_2 (200:75:75 g NPK per plant) resulted in significantly higher fruit weight per plant (1.777 and 1.902 kg) and fruit yield (1974.25 and 2113.62 kg/ha) during both 2020-21 and 2021-22, and was comparable to treatment F3 (300:100:100 g NPK per plant) in both years. Applying fertilizers increased the fruit yield of phalsa, with higher doses leading to even greater yields up to a certain point, after which the yield started to decline. Similar results were found in earlier studies on phalsa by Gill *et al.* (2015), Gochar *et al.* (2017), and Fareed *et al.* (2021), as well as in a study on guava by Baviskar *et al.* (2018).

Table 3. Effect of round-the-year pruning and fertilizer doses on yield parameters of phalsa

Treatment	Weight of fruit per plant (kg)		Fruit yield (kg/ha)	
	2020-21	2021-22	2020-21	2021-22
Pruning time				
P_1	1.669	1.771	1854.01	1967.33
P_2	1.777	1.902	1974.25	2113.62
P_3	0.264	0.262	293.06	290.96
P_4	0.212	0.226	236.03	251.21
P_5	1.363	1.459	1514.17	1620.58
P_6	1.179	1.193	1309.62	1325.79
SE(m)±	0.025	0.026	27.23	28.61
CD at 5 %	0.070	0.074	78.11	82.06
Fertilizer doses				
F_1	0.934	1.011	1038.11	1123.10
F_2	1.169	1.207	1298.20	1340.67
F_3	1.129	1.189	1254.26	1320.98
SE(m)±	0.017	0.018	19.26	20.23
CD at 5 %	0.050	0.052	55.23	58.03

This study found that pruning phalsa plants in the first week of March resulted in higher vegetative growth, early flowering, and higher yields. Higher doses of fertilizers (300:100:100 g NPK/plant) promoted early and vigorous vegetative growth, while lower doses (100:50:50 g NPK/plant) resulted in earlier flowering, fruit set, and picking. Pruning in the first week of March with fertilizer application of 200:75:75 g NPK/plant resulted in the highest fruit yield.

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