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Effect of different levels of pruning and nitrogen on growth, flowering, fruiting, yield and quality of *phalsa* (*Grewia subinequalis* D.C.)

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ABSTRACT

The present study was conducted with four levels of pruning (P_0-control, P_1-30 cm, P_2-60 cm and P_3-90 cm above the ground level) and four levels of nitrogen (N_0-control, N_1-40 g, N_2-80 g and N_3-120 g/plant). It has been observed from two year's experiment that average maximum shoot length (1.94 and 2.24 m) was recorded in P_0N_2, while maximum plant spread (1.83 and 2.20 m), number of canes per bush (16.40 and 20.54), number of days to flower bud initiation (110.5 and 110.80), highest number of fruits per plant (1576.47 and 1380.53), yield per bush (0.850 and 0.800 kg), yield per ha (1,888 and 1,777 kg/ha) respectively, were recorded highest in treatment P_3N_2. However, the highest 100-fruit weight (66.25 and 57.20 g) respectively, was recorded with P_1N_2. Highest TSS (17.40 and 18.00%) was recorded under the P_3N_3 and least acidity (2.90 and 3.25% in P_3N_0. Ascorbic acid content was highest (39.80 and 37.50 mg/100 g fr. wt.) in treatment combination P_2N_2. The juice and total sugars per cent was recorded highest (55.60, 50.60 and 15.25, 14.80%), respectively, in treatment combination P_1N_2 and reducing sugar was highest (12.2 and 12.8%) in P_3N_2. Treatment combination P_3 N_2 was the best for *phalsa* under Lucknow conditions.

Key words: *Grewia subinequalis*, pruning, nitrogen, yield, quality.

INTRODUCTION

Phalsa (*Grewia subinaequalis* D.C.), is popular fruit in subtropical and tropical regions and can be grown throughout the country (Singh, 9; Singh and Singh, 6). It is commercially cultivated in Punjab, Haryana, Uttar Pradesh and Andhra Pradesh. *Phalsa* bears small round pinkish fruits that are used as table fruits as well as have the medicinal properties. Because of short shelf-life, its fruits are suitable for local market or need to be processed immediately after harvesting. It is a rich source of vitamins A and C and comes in market in June when other fresh fruits are not available (Sharma *et al.*, 5). Children use its fruit as table fruit, otherwise; basically it makes ready-to-serve, beverages like juice, squash, syrup etc. (Singh *et al.*, 8).

Phalsa bears on current year's growth for this reason proper pruning are considered to be an essential operation in cultivation. It provides a long productive life to the plant, improves yield and fruit quality, besides regulating the growth and vigour of the plant (Abid *et al.*, 1). Nitrogen governs plant growth by virtue of being a major constituent of chlorophyll, protein, amino acids and photosynthetic activity (Rathore *et al.*, 3). However, very little information is available on the effect of severity of pruning and nitrogen fertilization in *phalsa* under Lucknow conditions.

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MATERIALS AND METHODS

The present investigation was carried out at the Horticulture Research Farm of the Department of Applied Plant Science, BBAU, Lucknow for two fruiting seasons. The soil of the experimental farm was saline with soil pH less than 8.2, EC more than 4.0 $dSm^{-1}$and sodium exchangeable percentage less than 15.0. The experiment was conducted on a 3-year-old *phalsa* plant of cv. Local planted at distance of 3 m × 1.5 m. The experiment was laid out in two factor RBD. Nitrogen in form of urea was applied in four different doses per plant. At full development stage after commencing the dormancy and shading the leaves in month of December, the pruning of branches were done at four levels, *i.e*. 30, 60, 90 cm from ground level and control (without pruning). Nitrogen was also applied in four different doses, *i.e*. 0 g (control), 40 , 80 and 120 g per plant after 10 days of pruning and was mixed in soil. The total amount of nitrogen was applied in three-split doses and observations were recorded, accordingly. The uniform cultural practices were. The observations were recorded on growth and yield characteristics, *viz*., shoot length at time of harvest (cm), average spread at time of harvest (cm), number of canes/bush, days to flower bud initiation, number of fruits per bush, 100 fruit weight (g), yield per bush (kg), yield/ha (kg). Chemical characteristics, *viz*., TSS (°Brix), acidity (%), ascorbic acid (mg/100 g fr. wt.), juice (%), total sugars (%), and reducing sugar (%) were analysed. The data recorded during observation was used for analysis to test the level of significance as per method given by (Fisher, 2).

RESULTS AND DISCUSSION

Levels of pruning more significantly affect the shoot length than application of nitrogen. The maximum shoot length (1.87 and 1.80 m) was recorded in P_3 (90 cm) level of pruning in during both years, respectively, while with application of nitrogen it was recorded the highest (1.79 and 1.70 m respectively) in N_2 levels (80 g/bush) of nitrogen during both the years. Due to interaction effect of pruning and nitrogen, maximum shoot length (1.94 and 2.24 m) in $P_0 N_2$ followed by (2.12 and 1.95 m) respectively in P_3N_2 and minimum shoot length (1.12 m) was in P_1N_2. Similar results were obtained by Singh *et al.* (10) who reported that height of new growth was minimum when pruned severely, whereas it was found maximum in control. Present findings are also in support with the results of Singh *et al.* (7) and Abid *et al*. (1).

The plant spread was recorded maximum (1.70 and 1.92 m) in P_3 (90 cm) level of pruning but decreased with increase in the severity of pruning, while among the different levels of nitrogen, the maximum spread of plant (1.73 and 1.90 m) recorded with N_2 (80 g N/plant) during both the years. The interaction effect of P × N was found to be highly significant. Maximum spread of shoot (1.83 and 2.20 m) was recorded with P_3N_2 (90 cm + 80 N g/plant. Variation in plant spread of *phalsa* observed is in agreement with the findings of Abid *et al*. (1). Maximum number of canes/ bush (13.90 and 18.50) was recorded with P_3 (90 cm), and N_2 (13.55 and 16.72) respectively. Interaction of pruning and nitrogen dose was recorded maximum (16.40 and 20.54) with P_3N_2 by application of 80 g N/ bush and with pruning at 90 cm however, it was recorded minimum (8.20 and 4.84) with P_0N_0, respectively during the both years. Earlier, Singh and Singh (6) got similar results.

In present experiment the number of days to flower bud initiation was recorded maximum (105.9 and 106.1) in plants spaced at P_3 (90 cm), which declined with the control (P_0) expressing a minimum number of days (97.8 and 95.5) respectively. The maximum number of days to flower bud initiation (105.6 and 103.8) was recorded with application of N_3 level of nitrogen (120 g N/bush). In the interactive effect of P × N, the maximum number of days to flower bud initiation (110.5 and 110.8) was recorded with $P_3 N_3$ (90 cm + 80 g per bush). This observation is also inconsonant with the observation of Singh *et al.* (8).

Maximum number of fruits per plant (1341.65 and 1275.87, respectively) was recorded with S_3 (90 cm) and by applying N_2 (80 g N/bush) dose it was maximum (1345.44 and 1275.80/bush). In interaction of spacing and nitrogen highest number of fruits per plant (1576.47 and 1380.53) was recorded with $P_3 N_2$ (90 cm + 80 g N per bush) respectively. The ability of *phalsa* plant to produce higher number of fruits is largely determined by the optimum supply of nitrogen and pruning (Abid *et al*., 1; Singh, 10).

Variations were observed for 100-fruit weight due to effect of pruning and nitrogen and their interactions during two years but no significant differences were noted. This observation is in agreement with the findings of Singh *et al.* (7) who reported that fruit weight was maximum in medium pruning due to healthy fruits have been better qualities. Abid *et al*. (1) also reported in favour of present findings. Among three pruning levels, maximum yield per bush (0.730 and 0.708 kg) was recorded in P_3 level of pruning, while, due to application of nitrogen it was recorded maximum (0.795 and 0.734 kg per bush, respectively), with the treatment N_2 (80g N per bush). The minimum yield per bush was recorded with the pruning (0.604 and 0.586 kg) and application of N dose of nitrogen (0.542 and 0.565 kg). The interaction between pruning and nitrogen, highest yield per bush (0.850 and 0.800 kg) respectively, was also recorded with P_3N_2 and lowest yield per bush (0.489 and 0.535 kg) respectively, with P_2N_0 (60 cm pruning + control). Abid *et al*. (1). It might be due to the accommodation of more branches in light pruning and higher number of fruits which directly attributed the increase in the fruit yield.

Application of nitrogen more significantly influence the yield per bush than pruning, it was recorded highest (1,766 and 1,632 kg yield per hectare) respectively, with the application of N_2 level of nitrogen and was recorded lowest (1205 and 1254) respectively. Levels of pruning also effect to yield per hectare significantly. It was recorded highest (1,622 and 1,574 kg per ha) respectively, in pruning treatment level P_3, which as noticed lowest (1,341 and 1,301 kg per ha) under the P_0 during the both year of experimentation. The interaction of pruning and nitrogen dose the highest yield per ha was recorded highest (1,888 and 1,777 kg) in treatment combination of P_3N_2 while, it was noticed least (1,113 and 1,188 kg) respectively, in treatment P_0N_0 (control. Higher yield per ha with light pruning and medium dose of nitrogen may be due more number of fruits bearing in light pruning, in comparison to sevre pruning and also develop average fruit weight with optimum dose of nitrogen.

The TSS was also affected by levels of pruning and nitrogen and their interaction significantly but highest TSS (16.23 and 16.27°B, respectively) was recorded in P_3 level of pruning which also recorded highest (16.57 and 16.77°B, respectively). In N levels, N_3 was most responsive during the both years. The lowest amount of TSS due to effect of pruning was noticed with P_1 (14.63 and 14.46°B) and (14.16 and 14.28°B, respectively). Interaction of pruning and nitrogen also influence to TSS significantly, which was recorded highest (17.4 and 18.00°B) was recorded under the treatment combination P_3N_3 during both years. The similar findings due to effect of pruning were also recorded by Abid *et al.* (1).

The fruit acidity highest (3.81 and 3.79%) in control (P_1) and lowest (3.48 and 3.57%) with P_3. The interaction of nitrogen and pruningt was noticed highest (3.85 and 5.00%, respectively) in treatment combination P_2N_1 during both years of experiment. Observations are in agreement with the observations of Abid *et al.* (1) and Rathore *et al*. (3) who reported that increase N level decrease fruit acidity.

Like acidity, ascorbic acid was also found to varying significantly in different treatments but there was no any linear relationship in ascorbic acid affected by the pruning and nitrogen and its interaction. The highest per cent of ascorbic acid (36.80 and 35.53 mg per 100 g fr. wt., respectively) was recorded in P_3 levels of pruning, which was lowest (30.17 and 31.11 mg, respectively). Due to effect of nitrogen, it was highest (36.57 and 35.47 mg per 100 g fr. wt.) respectively, with N_2 . The interaction of nitrogen and pruning it was noticed highest (39.80 and 37.50 mg per 100 g fr. wt.) respectively, in treatment combination P_2 N_2 and was recorded lowest (26.10 and 31.50 mg per 100 g fr. wt., respectively) during both years. The findings are in consonance with the findings of Singh *et al.* (7).

A high significant variation was observed due to effect of different levels of pruning and nitrogen. The per cent of juice and total sugars were recorded highest (53.22, 52.87% and 14.56, 14.08), respectively, under severe pruning P_1 and was lowest with P_0 (42.32, 41.50% and 10.70, 11.16% respectively), with the application of nitrogen it was recorded highest (51.42, 50.20% and 13.86, 13.45% respectively), in treatment N_2 and lowest (45.57, 47.20% and 11.11, 12.08%) under N_0. The interaction effect of pruning and nitrogen was maximum for juice (54.20 and 54.60%) under P_1N_1 and total sugars (15.25 and 14.80%) respectively, under P_1N_2 (sevre pruning and medium level of nitrogen). The observations were also similar recorded by Sharma and Chauhan (4). The reducing sugar was recorded highest with light pruning and medium level of nitrogen. Among pruning levels light pruning P_3 (90 cm) was recorded highest (11.68 and 11.69%) reducing sugar, while, it was lowest (9.0 and 8.45%) in P_0. With the application of nitrogen N_2 (80 g per bush) it was recorded highest (10.07 and 10.58%, respectively) under the N_2 levels of pruning during both the years. Highest reducing sugar (12.20 and 12.80%, respectively) was noticed in P_3N_2 treatment.

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Table 1. Growth and yield attributes of *phalsa* as affected by different levels of pruning and nitrogen levels.

Treatment	Shoot length (m)		Plant spread (m)		No. of canes per bush		No. of days to flower bud initiation		No. of fruits/ bush		100-fruit wt. (g)		Yield/ bush (kg)		Yield/ ha (kg)	
	1st y	2nd y	1st y	2nd y	1st y	2nd y	1st y	2nd y	1st y	2nd y	1st y	2nd y	1st y	2nd y	1st y	2nd y
P0	1.77	1.74	1.67	1.66	8.53	8.74	97.8	95.5	1162.02	1095.84	52.75	53.87	0.604	0.586	1341	1301
P1	1.33	1.31	1.27	1.28	11.90	13.81	100.3	98.1	1054.00	1190.14	57.90	53.30	0.615	0.636	1366	1414
P2	1.41	1.52	1.44	1.78	13.27	16.57	100.8	101.5	1215.53	1205.50	54.57	54.00	0.669	0.649	1486	1442
P3	1.87	1.80	1.70	1.92	13.90	18.50	105.9	106.1	1341.65	1275.87	54.34	55.35	0.730	0.708	1622	1574
CD at 5% (P)	0.048	0.067	0.059	0.068	0.528	0.573	1.493	1.345	43.63	49.38	1.47	1.48	0.016	0.028	47.94	49.84
N0	1.51	1.37	1.43	1.37	10.60	13.02	97.0	97.0	1016.60	1057.16	53.30	53.62	0.542	0.565	1205	1254
N1	1.56	1.63	1.36	1.71	11.92	14.38	101.3	101.3	1192.67	1165.86	58.28	55.27	0.695	0.646	1543	1434
N2	1.79	1.70	1.73	1.90	13.55	16.72	100.9	99.1	1345.44	1275.80	59.51	57.57	0.795	0.734	1766	1632
N3	1.51	1.67	1.55	1.65	11.54	13.50	105.6	103.8	1218.59	1268.50	48.48	50.07	0.585	0.635	1300	1410
CD at 5% (N)	0.048	0.067	0.059	0.068	0.528	0.573	1.493	1.345	43.63	49.38	1.47	1.48	0.016	0.028	47.94	49.84
P0N0	1.80	1.24	1.55	1.13	8.20	4.84	92.3	94.3	956.10	960.50	52.40	55.70	0.501	0.535	1113	1188
P0N1	1.72	1.81	1.64	1.70	7.48	8.95	100.6	93.5	1008.69	927.27	57.50	55.00	0.580	0.510	1288	1133
P0N2	1.94	2.24	1.82	2.00	10.00	10.80	95.7	97.1	1207.90	1141.59	58.40	56.50	0.705	0.645	1566	1433
P0N3	1.62	1.68	1.67	1.84	8.45	10.39	102.6	97.2	1475.40	1354.03	42.70	48.30	0.630	0.654	1399	1453
P1N0	1.22	1.40	1.20	1.00	10.20	13.00	94.8	95.5	935.20	1108.98	55.60	52.30	0.520	0.580	1155	1288
P1N1	1.45	1.30	1.00	1.42	12.40	13.60	97.2	101.2	1119.50	1183.48	59.40	54.50	0.665	0.645	1477	1433
P1N2	1.51	1.12	1.48	1.52	11.50	17.50	105.4	98.8	1177.27	1346.15	66.25	57.20	0.780	0.770	1733	1710
P1N3	1.14	1.42	1.43	1.20	13.50	11.14	103.8	96.8	984.12	1121.95	50.40	49.20	0.496	0.552	1102	1226
P2N0	1.32	1.24	1.24	1.66	11.20	16.44	98.3	98.5	966.40	983.45	50.60	54.40	0.489	0.535	1086	1188
P2N1	1.28	1.52	1.35	1.89	13.60	16.80	99.0	102.2	1302.49	1234.61	56.20	52.50	0.732	0.648	1626	1439
P2N2	1.62	1.50	1.81	1.91	16.30	18.04	100.5	95.0	1420.16	1235.00	59.50	58.70	0.845	0.725	1877	1610
P2N3	1.45	1.84	1.38	1.66	12.00	15.00	105.3	110.3	1173.07	1369.04	52.00	50.40	0.610	0.690	1355	1533
P3N0	1.72	1.60	1.76	1.72	12.80	17.8	102.6	99.7	1208.33	1175.76	54.62	52.00	0.660	0.610	1466	1355
P3N1	1.80	1.92	1.48	1.84	14.20	18.2	108.4	108.3	1340.00	1318.00	60.00	59.10	0.804	0.780	1786	1733
P3N2	2.12	1.95	1.83	2.20	16.40	20.54	102.3	105.4	1576.47	1380.53	53.95	57.90	0.850	0.800	1888	1777
P3N3	1.84	1.74	1.73	1.93	12.22	17.46	110.5	110.8	1241.80	1229.00	48.80	52.40	0.606	0.644	1346	1430
CD at 5% (P × N)	0.096	0.133	0.119	0.136	1.056	1.15	2.987	2.69	87.27	98.76	2.95	2.96	0.033	0.056	95.89	99.68

Table 2. Chemical characteristics of *phalsa* as affected by different levels of pruning and nitrogen.

Parameter	TSS (°Brix)		Acidity (%)		Ascorbic acid (mg/100 g fr.wt.)		Juice (%)		Total sugars (%)		Reducing sugar (%)	
Treatment	1st y	2nd y	1st y	2nd y	1st y	2nd y	1st y	2nd y	1st y	2nd y	1st y	2nd y
P0	14.63	14.46	3.94	3.41	30.17	32.05	42.32	41.50	10.43	11.16	9.00	8.45
P1	15.06	15.08	3.81	3.79	33.20	31.96	53.22	52.87	14.56	14.08	8.58	8.91
P2	15.40	15.66	3.72	3.89	36.80	35.53	52.02	52.27	13.52	13.20	10.64	10.16
P3	16.23	16.27	3.48	3.57	36.96	35.25	47.80	48.50	12.67	12.90	11.68	11.69
CD at 5% (P)	0.50	0.58	0.072	0.036	0.072	0.153	0.69	0.75	0.108	0.072	0.114	0.091
N0	14.87	14.75	3.16	3.51	30.91	33.13	45.57	47.80	11.11	12.08	9.98	8.91
N1	14.16	14.28	4.19	3.81	35.10	32.68	47.95	48.15	13.56	13.51	10.26	10.33
N2	15.72	15.67	3.63	3.55	36.57	35.47	51.42	50.22	13.86	13.45	10.07	10.57
N3	16.57	16.77	3.99	3.79	33.50	33.50	50.42	49.57	12.67	12.30	9.60	9.37
CD at 5% (N)	0.50	0.58	0.072	0.036	0.072	0.153	0.69	0.75	0.108	0.072	0.114	0.091
P0N0	14.25	14.75	3.20	3.60	26.10	31.50	38.70	39.50	8.56	9.75	8.35	7.25
P0N1	13.80	13.60	4.65	3.25	33.0	30.33	41.20	42.00	10.20	12.80	8.25	8.75
P0N2	15.10	14.50	4.14	3.30	31.60	34.00	43.90	43.50	12.20	11.80	10.20	9.00
P0N3	15.40	15.00	3.80	3.50	30.00	32.40	45.50	41.00	10.70	10.30	9.20	8.80
P1N0	14.40	14.80	2.90	3.60	28.00	32.00	51.70	52.50	13.80	13.20	8.80	8.00
P1N1	14.15	13.85	4.15	3.55	35.50	29.50	54.20	54.60	15.20	13.95	9.60	9.20
P1N2	15.80	15.20	4.40	3.80	35.40	33.80	55.60	50.60	15.25	14.80	8.20	9.80
P1N3	15.90	16.50	3.80	4.20	33.90	32.50	51.40	53.80	14.00	14.40	7.75	8.65
P2N0	15.10	14.85	3.65	3.60	32.80	32.85	50.40	51.50	12.20	12.80	10.29	8.92
P2N1	13.50	14.20	3.85	5.00	37.30	36.20	52.60	53.50	14.40	13.50	12.40	11.20
P2N2	15.40	16.00	3.00	3.50	39.80	37.50	53.80	51.80	14.40	14.00	9.68	10.72
P2N3	17.60	17.60	4.40	3.45	37.30	35.60	51.30	52.30	13.10	12.50	10.25	9.80
P3N0	15.76	14.60	2.90	3.25	36.75	36.20	41.50	45.30	9.80	12.60	12.50	11.50
P3N1	15.20	15.50	4.10	3.45	34.80	34.70	43.80	42.50	14.40	13.80	10.80	12.20
P3N2	16.60	17.00	3.00	3.60	39.50	36.60	52.40	55.00	13.60	13.20	12.20	12.80
P3N3	17.40	18.00	3.95	4.00	32.80	33.50	53.50	51.20	12.90	12.00	11.24	10.26
CD at 5% (P × N)	1.00	1.15	0.144	0.072	0.144	0.306	1.38	1.50	0.216	0.144	0.229	0.182

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