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Response of pruning intensity and nutrients on vegetative growth parameters and yield of Aonla (*Emblica officinalis* Gaertn.) cv. Francis

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Abstract

Pruning is very effective to induce healthy current season growth. It also responds to slow growing trees by maintaining the size and shape without sacrificing yield. Further, proper nutrient management is also essential to maintain soil fertility and plant nutrient supply to an optimum level. The aonla plant responses the light as well as severe pruning. Thus, an investigation on response of pruning and nutrient management on vegetative growth and fruit yield has been conducted during the two consecutive years.

The maximum increase in vegetative growth characteristics, fruit yield and quality was found in 50% pruning intensity along with nutrient management by use of FYM (40 kg) and NPK (1000:500:1000 g/plant). Since, pruning remove carbon-starved, fruiting exhausted shoots and promotes new leaf growth to build up carbohydrate reserves for the next flowering that allows the sprouting of lateral buds hence, ultimately influenced the plant growth, spread, trunk girth and other vegetative characteristics of the plants. The significant interactive effect of treatments was attributed to the favourable nutritional status of the leaf and soil resulting into increased biomass production of the fruit. A significant increase in yield and yield parameters in aonla with nutrient application would have been due to vigorous vegetative growth and increased chlorophyll content, which together accelerated the photosynthesis that increased the supply of carbohydrates to plants.

Key words: aonla, pruning, antiscorbutic, senile, rejuvenation, photosynthates,

Introduction

Aonla (*Emblica officinalis* Gaertn.) is an important and highly remunerative arid fruit plant that grows under wide range of agro-climatic conditions without much care. The aonla fruit has been recognized throughout the world as health care drug, valued to restore vitality and remedy of a number of body ailments. The fair amount of polyphenols and tannins (gallic acid, elagic acid and glucose), found in fresh and dried aonla fruit, retard the oxidation of vitamin C and functions as antiscorbutic element.

In spite of being such a valuable crop, most of the old aonla orchards are declining in terms of productivity and quality of fruits due to sole reason of poor management practices. Hence, there is dire need to improve the health and productivity of such unproductive/senile orchards through application of rejuvenation technology, efficient management practices of nutrients, moisture management, organic farming and control over pests and diseases. With these objectives an investigation on response of pruning and nutrient management on vegetative growth and fruit yield has been conducted during the two consecutive years, 2007 and 2008.

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Materials and Methods

The field experiment was conducted at Main Experiment Station, Department of Horticulture, NDUAT, Faizabad, Uttar Pradesh. Thirty-six plants of sixteen years old aonla cv. Francis; uniform in size and growth, planted at a distance of 10×10 m were selected. The experiment was laid out in a Factorial Randomized Block Design with 3 replications having 12 treatment combinations including 3 levels of pruning (un-pruned, 25% and 50% removal of one year old shoot), 2 levels of organic (Bio-press mud 20 kg/ tree and FYM 40 kg/tree) and inorganic nutrients (50% and 100% RDF).

The full dose of FYM, bio-press mud, phosphorus, potassium and half dose of nitrogen were applied as a basal dose in the month of February, while another 1/2 dose nitrogen was applied after fruit bud bursting in the month of September. Pruning was done in the second week of February. Observations were recorded on the plant height, spread, trunk girth, number of determinate and indeterminate shoots per pruned and un-

pruned shoots, days taken to sprouting, per cent fruit set, days taken to fruit maturity and yield.

Results and discussion

Effect of pruning intensity on vegetative growth parameters

The data presented in the Table-1(a) and (b) showed that plant height, determinate and indeterminate shoots and days taken to sprouting was significantly influenced by pruning intensity in both the years of experimentation while plant spread was influenced only in 2008. The maximum increase in plant height was recorded in P_2 (50% pruning of previous season growth) 14.31 and 14.00 per cent and minimum in P_0 (control) 11.81 and 10.58 per cent during 2007 and 2008 respectively. The maximum plant spread was found to be 12.79 per cent in P_2 and minimum 9.98 per cent in P_0 during 2008 but did not leave much effect in the year 2007. Application of various pruning intensity did not show significant influence on girth of trunk during both the years of experimentation.

Further, significantly maximum number of the determinate shoots (35.75, 34.67) and indeterminate shoots (6.06, 6.02) were observed under P_0 as compared to minimum determinate and indeterminate shoots under P_2 (27.50, 28.58) and (3.70, 3.92) during both years respectively. The maximum days taken to sprouting was obtained under P_2 (11.67 and 13.25 days) as compared to P_0 (7.75 and 5.75 days) in the years 2007 and 2008 respectively.

Effect of organic manures and nutrient management on vegetative growth parameters

A perusal of data presented in Table-1(a) reveal that application of organic manures and nutrients did not show significant influence on plant height, spread, girth of trunk and indeterminate shoots during both the years of experimentation. Nevertheless, application of nutrients through 100 % RDF (1000:500:1000 g/tree NPK) and 50 % RDF (500:250:500 g/tree NPK) left significant effect on increase of trunk girth (17.17 per cent) and minimum days taken to sprouting (10.17 days) during 2008. Again, application of recommended dose of nutrients showed significant effect on number of the determinate shoots were noticed under N_2 (34.67 in both years) and minimum under N_1 (28.78, 29.11) during 2007 and 2008 respectively.

Effect of interaction treatments on vegetative growth parameters

The data related to effect of interaction treatments on plant height, spread, trunk girth, determinate shoot, indeterminate shoot and days taken to sprouting are presented in Table-1(a) and (b). There was significant maximum increase in plant height (16.00 and 16.67 per cent) under $P_2M_2N_1$ and $P_2M_2N_2$ and minimum (10.83 and 10.16 per cent) under $P_0M_1N_1$ and $P_0M_1N_2$ was found during 2007 and 2008, respectively. Interaction effect on plant spread is significant in 2008 with maximum and minimum values (13.92 and 9.82 per cent) under $P_2M_2N_2$ and $P_0M_2N_2$, respectively. Trunk girth was insignificantly influenced during both the years.

The significantly maximum number of the determinate shoots (40.00 and 38.33) under $P_0M_2N_2$ and minimum (24.00 and 25.33) under $P_2M_2N_1$ were noticed during 2007 and 2008, respectively. Further, maximum number of the indeterminate shoots (6.75) under $P_0M_2N_2$ in 2007 and (6.3) under $P_0M_1N_1$ and $P_0M_2N_1$ during 2008 and minimum (2.98 and 1.30) under $P_2M_2N_1$ and $P_2M_1N_1$ was noticed during 2007 and 2008 respectively. The minimum days (6.7 and 5.0 days) were taken for sprouting with treatment $P_0M_1N_1$ and $P_0M_2N_2$, respectively whereas, maximum (13.7 and 15.0 days) under $P_2M_2N_1$ during both years 2007 and 2008.

Since, pruning remove carbon-starved, fruiting exhausted shoots and promotes new leaf growth to build up carbohydrate reserves for the next flowering that allows the sprouting of lateral buds hence, ultimately influenced the plant growth, spread, trunk girth and other vegetative characters of the plants. The findings are in accordance with Dhaliwal *et al.* (2000) in guava and Singh (2005) in aonla.

The increase in plant height, spread, number of determinate and indeterminate shoots would have been caused due to the acceleration of the movement of assimilates and increase in translocation of photosynthates as a result of NPK application (Hartt, 1969; Teaotia *et al.*, 1972 in guava and Glonti, 1972 in orange) whereas, the result of combined use of fertilizers and organic manures are in close agreement with the findings of Santhy *et al.* (2001) who reported that integrated nutrient supply increased organic carbon, available nitrogen, sulphur, manganese and iron improving soil fertility.

Effect of pruning intensity on yield parameters

It is evident from the data presented in Table-2 that irrespective of any treatment, the initiation of the flowering in aonla started as early as on March 23 and latest by March 30 during 2007 and from March 22 to March 31 in 2008. It is crystal clear from the data that the response of pruning on fruit set, duration of fruit maturity and fruit yield had been significant in both years. Maximum fruit set (71.74 and 70.54 per cent) and fruit yield (125 and 130 kg/tree) was noticed in P_2 whereas minimum (58.37 and 57.72 per cent) and (98 and 100 kg/tree) in P_0 Further, the minimum days taken to fruit maturity (218 days in both years) was also found to be in P_2 as compared to P_0 (228 and 229 days).

Effect of organic manures and nutrient management on yield parameters

The result obtained under present investigation presented in Table-2 reveals that application of organic and inorganic nutrient management significantly improve

Table-1(a). Effect of the pruning intensity, organic manure and nutrient management on plant growth characteristics (per cent increase over initial plant growth)

Treatments	Plant height (%)		Plant spread (%)		Trunk girth (%)	
	2007	2008	2007	2008	2007	2008
Pruning						
P_0	11.81	10.58	09.33	09.98	16.92	14.25
P_1	13.51	12.42	09.30	10.57	18.00	17.08
P_2	14.31	14.00	09.83	12.79	18.33	15.83
SEm ±	**0.286**	**0.381**	**0.381**	**0.423**	**1.105**	**1.169**
CD at 5%	**0.837**	**1.111**	**NS**	**1.239**	**NS**	**NS**
Organic Manures						
M_1	12.89	11.92	09.31	10.83	18.45	15.78
M_2	13.53	12.77	09.66	11.40	17.06	15.67
SEm ±	**0.234**	**0.310**	**0.310**	**0.346**	**0.902**	**0.954**
CD at 5%	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
Nutrients						
N_1	13.23	12.11	09.62	10.91	16.84	14.28
N_2	13.19	12.58	09.35	11.32	18.67	17.17
SEm ±	**0.234**	**0.310**	**0.310**	**0.346**	**0.902**	**0.954**
CD at 5%	**NS**	**NS**	**NS**	**NS**	**NS**	**2.792**
Interaction						
$P_0M_1N_1$	10.83	10.67	09.17	10.10	16.67	12.67
$P_0M_1N_2$	12.50	10.16	08.88	10.06	19.00	15.67
$P_0M_2N_1$	11.90	10.93	09.47	09.93	14.67	13.00
$P_0M_2N_2$	12.00	10.67	09.80	09.82	17.33	15.67
$P_1M_1N_1$	13.47	13.00	09.97	09.93	17.67	16.00
$P_1M_1N_2$	14.00	12.33	08.32	10.97	20.00	18.67
$P_1M_2N_1$	13.63	11.67	09.77	10.44	18.23	15.00
$P_1M_2N_2$	12.95	12.67	09.13	10.92	16.00	18.67
$P_2M_1N_1$	13.57	12.33	09.58	11.71	18.00	15.33
$P_2M_1N_2$	13.00	13.00	09.97	12.19	19.33	16.33
$P_2M_2N_1$	16.00	14.00	09.78	13.32	15.67	13.66
$P_2M_2N_2$	14.67	16.67	10.00	13.92	20.33	18.00
SEm ±	**0.572**	**0.759**	**0.761**	**0.847**	**2.210**	**2.337**
CD at 5%	**1.674**	**2.222**	**NS**	**2.481**	**NS**	**NS**

the flowering attributes, fruit set and fruit maturity period during both the years except fruit yield only during 2008.

The maximum fruit set (66.80 and 65.95 per cent), fruit yield (115 and 119 kg/tree) and minimum days taken to fruit maturity (222 days in both years) were found under organic manure (M_2) whereas minimum (60.84 and 60.07 per cent), (108 and 110 kg/tree) and maximum (224 days, 226 days) under M_1 during both years 2007 and 2008 respectively Similarly, the maximum fruit set (64.89 and 64.50 per cent), fruit yield (115 and 118 kg/tree) and minimum days taken to fruit maturity in M_2 (221 and 222 days) was noticed under nutrients N_2 and minimum (62.78 and 61.52 per cent), (109 and 111kg/tree) and maximum (225 days and 226 days) due to the treatment N_1

Effect of interaction treatments on yield parameters:

The significant effect was observed due to interaction of different levels of pruning intensity, organic manure and nutrients on fruit set, days taken to maturity and fruit yield .

The earliest flower initiation was started from March 23 recorded in $P_0M_2N_2$ during 2007 and from March

Table-1(b). Effect of pruning intensity, organic manure and nutrient management on plant growth characteristics

Treatments	No. of determinate shoots		No. of indeterminate shoot (Days)		Days taken to sprouting	
	2007	2008	2007	2008	2007	2008
Pruning						
P0	35.75	34.67	06.06	06.02	07.75	05.75
P1	31.92	32.42	04.60	04.88	08.42	08.75
P2	27.50	28.58	03.70	03.92	11.67	13.25
SEm ±	**0.953**	**1.086**	**0.293**	**0.297**	**0.736**	**0.536**
CD at 5%	**2.788**	**3.177**	**0.857**	**0.868**	**2.154**	**1.568**
Organic Manure						
M1	31.94	31.89	04.62	04.51	08.72	09.17
M2	31.50	31.89	04.96	05.37	09.83	09.33
SEm ±	**0.778**	**0.887**	**0.239**	**0.242**	**0.601**	**0.438**
CD at 5%	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
Nutrients						
N1	28.78	29.11	04.76	04.76	09.39	10.17
N2	34.67	34.67	04.82	05.13	09.17	08.33
SEm ±	**0.778**	**0.887**	**0.239**	**0.242**	**0.601**	**0.438**
CD at 5%	**2.276**	**2.594**	**NS**	**NS**	**NS**	**1.658**
Interactions						
P0M1N1	35.00	34.33	06.00	06.30	06.70	05.00
P0M1N2	38.00	36.00	05.00	06.00	07.30	06.00
P0M2N1	30.00	30.00	06.50	06.30	08.00	07.00
'P0M2N2	40.00	38.33	06.75	05.40	09.00	05.00
P1M1N1	28.67	29.00	04.55	04.70	09.00	10.00
P1M1N2	34.00	34.67	04.60	05.00	08.30	08.00
P1M2N1	28.00	28.33	04.50	04.67	09.00	10.00
P1M2N2	37.00	37.67	04.75	05.16	07.30	07.00
P2M1N1	27.00	27.67	04.00	01.30	10.00	14.00
P2M1N2	29.00	29.67	03.57	03.76	11.00	12.00
P2M2N1	24.00	25.33	02.98	05.20	13.70	15.00
P2M2N2	30.00	31.67	04.30	05.40	12.00	12.00
SEm ±	**1.906**	**2.171**	**0.586**	**0.593**	**1.473**	**1 . 0 7 2**
CD at 5%	**5.57**	**66.3531.713**	**1.736**	**4.308**		

22 in 2008 in $P_0M_1N_1$ treatment. The late flower initiation was seen in $P_2M_2N_1$ (March 30) during 2007 and $P_2M_2N_2$ in 2008 (March 31). It is also evident that with increase in pruning intensity time of flower initiation was delayed.

Maximum fruit set (74.92 and 74.61 per cent) and fruit yield (139 and 145 kg/tree) was noticed in $P_2M_2N_2$ and minimum fruit set (53.38 and 53.18 per cent) and (88 and 89 kg/tree) in $P_0M_1N_1$ during the years 2007 and 2008, respectively. Further, minimum days of maturity period were noticed under $P_2M_2N_2$ (215 and 216 days) and maximum days under $P_0M_1N_1$ (232 and 237 days) during 2007 and 2008, respectively.

Chandra and Govind (1995) found maximum fruit yield (9.18 kg/tree) with 75 per cent pruning in the month of February whereas, good quality was obtained with 25 per cent pruning in guava. Kundu *et al.* (1995) also found that yields were reduced significantly as the pruning severity was increased. Mishra and Pathak (1998) reported that 50 per cent pruning in May produced highest yield (25.8 kg/tree) than un-pruned (7.6 kg/tree) in winter crop of guava cv. Sardar.

However, other factors like cultural practices and nutrition of the plants also influenced flowering characters to an appreciable extent, (Tripathi and Maity 2007). The

Table-2. Effect of pruning intensity, organic manure and nutrient management on flowering and fruiting characteristics

Treatments	Time of flower initiation (Date)		Fruit set (%)		Days taken to fruit maturity (Days)		Fruit yield (kg/tree)	
	2007	2008	2007	2008	2007	2008	2007	2008
Pruning								
P_0	Mar.25	Mar.25	58.37	57.72	228	229	98	100
P_1	Mar.27	Mar.27	61.34	60.78	223	224	111	114
P_2	Mar.29	Mar.30	71.74	70.54	218	218	125	130
SEm ±	-	-	0.235	0.850	0.783	0.399	2.326	1.384
CD at 5%	-	-	0.687	2.487	2.291	1.166	6.804	4.050
Organic manure								
M_1	Mar.27	Mar.26	60.84	60.07	224	226	108	110
M_2	Mar.27	Mar.28	66.80	65.95	222	222	115	119
SEm ±	-	-	0.192	0.694	0.639	0.325	1.91	1.130
CD at 5%	-	-	0.561	2.031	1.870	0.952	NS	3.306
Nutrients								
N_1	Mar.27	Mar.27	62.78	61.52	225	226	109	111
N_2	Mar.26	Mar.27	64.89	64.50	221	222	115	118
SEm ±	-	-	0.192	0.694	0.639	0.325	1.91	1.130
CD at 5%	-	-	0.561	2.031	1.870	0.952	NS	3.306
Interactions								
$P_0M_1N_1$	Mar.24	Mar.22	53.38	53.18	232	237	88	89
$P_0M_1N_2$	Mar.26	Mar.25	54.67	54.39	225	225	98	98
$P_0M_2N_1$	Mar.26	Mar.27	62.00	59.67	227	227	102	105
$P_0M_2N_2$	Mar.23	Mar.24	63.41	63.63	228	228	105	108
$P_1M_1N_1$	Mar.26	Mar.25	57.45	55.81	227	227	110	110
$P_1M_1N_2$	Mar.27	Mar.28	59.45	61.48	223	224	112	115
$P_1M_2N_1$	Mar.28	Mar.27	61.43	60.46	222	223	111	113
$P_1M_2N_2$	Mar.25	Mar.26	67.03	65.34	221	222	112	116
$P_2M_1N_1$	Mar.29	Mar.28	70.39	67.98	223	224	117	121
$P_2M_1N_2$	Mar.28	Mar.29	69.67	67.56	216	216	122	127
$P_2M_2N_1$	Mar.30	Mar.30	72.00	72.00	217	218	123	125
$P_2M_2N_2$	Mar.29	Mar.31	74.92	74.61	215	216	139	145
SEm ±	-		0.470	1.700	1.566	0.797	4.651	2.768
CD at 5%	-		1.374	4.974	4.581	2.332	13.608	8.099

application of organic manures might have increased the production of organic acids which play a leading role in availability of P (Mukherjee *et al.*, 1991) that would have induced early flowering than its counter part. Organic manures attributes favourable effect on microbial and root proliferation in soil, which caused solubilizing effect on native N, P, K and other nutrients (Nambiar, 1994).

Combined application of organic manures and fertilizers favour vigorous growth and synthesized more cytokinin in plants which might have helped in translocation of this synthesized cytokinin as well as more quantity of available phosphorus through the xylem vessels and the accumulation of cytokinin and phosphorus in these axillary buds would have favoured the plant to enter into reproductive phase (Dange *et al.*, 2002).

A significant increase in yield and yield parameters in aonla with nutrient application wousld have been due to vigorous vegetative growth and increased chlorophyll content, which together accelerated the photosynthesis that increased the supply of carbohydrates to plants. The beneficial role of supplemented organic manures in improving soil physical, chemical and biological activities is well known, that helped in better nutrient absorption by plants, resulting higher yield (Prabu *et al*., 2002).

References:

Chandra, R. and Govind, S. 1995. Influence of time and intensity of pruning on growth, yield and fruit quality of guava under high density planting. *Tropical Agriculture*, 72: 110-113.

Dange, R.G., Naik, D.M. and Prabu, T. 2002. Effect of organic and inorganic fertilizers on growth, yield and quality of chilli (*Capsicum annum* L.). *South Indian Horticuture*, 50: 578-583.

Dhaliwal, G.S., Rattanpal, H.S. and Gill, H.S. 2000. Effect of time and severity of pruning on cropping and physico-chemcial properties of Sardar guava. *Haryana Journal of Horticultural Science*, 29: 27-20.

Glonti, F. 1972. The effect of nitrogen fertilizer rates and some external factors on growth and development of Washington Navel Orange. *Subtropical Cheskie Kul 'tury*, 6: 101-106.

Hartt, C.E. 1969. Effect of potassium efficiency upon translocation of 14 C in attached blades and entire plants of sugarcane. *Plant Physiology*, 44: 1461-1469.

Kundu, S.S.; Pareek, O.P. and Gupta, A.K. 1995. Effect of time and severity of pruning on physico-chemical characteristics of ber (*Ziziphus mauritiana* L.). *Haryana J. Hort.* Sci., 24(1): 53-58.

Mishra, H.K. and Pathak, R.A. 1998. Effect of shoot pruning on crop regulation in guava (*Psidium guajava* L.) cv. Sardar. *Progressive Horticulture*, 30: 78-81.

Mukherjee, D., Mitra, S. and Das, A. C. 1991. Effects of oil cakes on changes in carbon, nitrogen and microbial population in soil. *Journal of Indian Society Soil Scien*ce, 39: 457-462.

Nambiar, K.K.M. 1994. Soil fertility and crop productivity under long-term fertilizer use in India. ICAR, New Delhi.

Prabu, T., Narwadkar, P.R., Sajindranath, A.K. and Rathod, N.G. 2002. Integrated nutrient management in coriander. *South Indian Horticultur*e, 50: 680-684.

Santhy, P., Muthuvel, P. and Selvi, D. 2001. Status and impact of organic matter fractions on yield, uptake and available nutrients in a long term fertilizer experiment. *Journal of Indian Society Soil Science*, 49: 281-285.

Singh, S.K. 2005. Studies on pruning behaviour in aonla (*Emblica officinalis* Gaertn.) cv. Narendra Aonla-7. *Thesis submitted for M.Sc.(Ag) in Horticulture, NDUAT, Faizabad.*

Teaotia, S.S., Tripathi, R.S. and Phogat, K.P.S. 1972. Effect of nitrogenous, phosphatic and potassic fertilizers on growth, yield and quality of guava. *International Symposium on Subtropical and Tropical Horticulture, Horticultural Society of India*, pp. 139-140.

Tripathi, P. and Maity, T. K. 2007. Evaluation of summer okra (*Abelmoschus esculentus* (L.) Moench) hybrids under reduced level of chemical fertilizers. *Orissa Journal of Horticu*lture, 35: 6-13.