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ASSESSMENT OF REJUVENATION TECHNOLOGY AND IPNM IN AONLA ORCHARD: A WAY TOWARDS TRANSFORMATION & CONSERVATION OF SENILE AND UNPRODUCTIVE ORCHARD

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ABSTRACT

Present study was carried out to rejuvenate a 15- year old unproductive senile Aonla orchard at the Horticulture farm of Krishi Vigyan Kendra, P.G. College Ghazipur, U.P. during 2010 to 2015 to assess the Rejuvenation technology in location specific condition for creating awareness in farming community of the Ghazipur district through demonstration. Rejuvenation practices including top working with improved cultivar Narendra Aonla-6 and Narendra Aonla-7 along with IPNM were applied on selected trees.

Pooled fruit yield data of experiment indicated that the yield in initial year was low in Top worked plants T1 (24.90 kg/tree) and pruned plants T2 (25.50 kg/tree) as compared to farmers practice T3 (Control) yield *i.e.*27.00 kg /tree. But due to profuse bearing in subsequent production year *i.e.* 2014 to 20115 paradigm shift in production was observed. The increased yield of T1 and T2 were observed much higher 90.20 per cent and 44.80 per cent respectively over farmers practice(Control:T0). However, economic analysis revealed that B:C ratio were reported higher in T1 (5.8) than the T 2(4.44) and farmers practice T3(3.27). The technology was demonstrated to farmers by organizing field visit time to time to orient the growers.

INTRODUCTION

Indian gooseberry (*Emblica officinalis*) popularly known as Aonla is indigenous fruit crop of Indian sub-continent and mentioned as amrit phal in several Hindu Dharmgranths due to its unbelievable medicinal and anti aging property. Though the India ranks first in the world in area and production of this crop, but uneconomic production with low quality of fruits of indigenous local races/varieties in old and senile Aonla orchard due to poor nutrient supply and management practices become common at the most of Aonla grower's field which is being resulted in destruction of orchard on farmers field (Singh 2005). Old and senile orchards are mostly mismanaged and characterized by intermingling and overcrowded branches which invite the infestation of pest and diseases and yield and quality of fruit affected adversely (Singh and Singh 2003).

As Aonla bears flowering and fruiting on new growth, it is observed that Aonla is well responsive to pruning practices for flowering and fruiting (M.P.Patel *et al*., 2004).Hence deep pruning of older branches of senile and uneconomical Aonla orchard to maintain the architecture of plant and reduce the size, not only induces healthy current season growth but also minimize excessive utilization of nutrients by undesirable branches. (Kumar *et al*., 2014) Rejuvenation technology may be referred as an integrated approach to recover the growth and yielding potential of plant by making it new through pruning and canopy management in established orchards. Hence application of rejuvenation technology in unproductive orchard of Aonla is required to be standardized and demonstrated to farmers for the conservation of Aonla orchard in Gangatic plains. Though the technology is able convert old orchard in new one with high yielding and quality produce but intensive care and training is required for skillful management of nutrition and adequate irrigation at scheduled time in different location otherwise it may be resulted as dying of plant at larger scale. Hence present study was undertaken to validate the package of rejuvenation technology developed by Singh and Mishra (2007) along with IPNM to achieve foresaid objective on the Aonla orchard of KVK, PG College Ghazipur and create awareness by demonstration of technology to farmers.

MATERIALS AND METHODS

Present study was conducted at the Horticulture farm of Krishi Vigyan Kendra, P.G.College district Ghazipur, U.P lies to the east and north of the Jaunpur and Varansai district respectively between the parallels of 25° 192 and 25° 542 north latitude and 83° 42 and 83° 582 east longitude. This location is 67.50 Mt. above the sea level. This Place is a part of mid gangetic plain having mild climate with a temperature variation 5 to 17 Celsius in winter and 30 to 42 Celsius in summer. 15 year old Aonla plants of said orchard comprising 36 plants characterized by partial and uneconomic yield were selected to conduct the study. These plants had attained full vegetative growth with no or very poor economic bearing even after achieving proper maturity. This was might be due failure of

grafted bud and development of plants through buds aroused from rootstock and orchard is converted in indigenous seedling orchard. Similar problems of poor bearing of Aonla orchard had also been reported at many growers field. A survey among the Aonla growers of district Ghazipur was conducted to identify technological gap and obtain feedback on constraints experienced by farmers and other stakeholders e.g. officials of agriculture and horticulture departments.

Total 15 plants out of thirty-six were selected to apply the techniques of rejuvenation having marked decline in yield to assess the practice of rejuvenation techniques in Aonla developed by PFDC (Singh and Mishra 2007) Plants were selected randomly and headed back from a height of 2.5 meters followed by pasting of copper oxychloride in December 2010.Newly emerged shoots on the stump as a results of rejuvenation pruning were allowed to grow selectively in all direction. (Bairwa et al. 2016) Thinning of these shoots on pruned plants were followed with leaving 5-6 shoots on each stump in all direction allowed to grow up in May 2011 on the pruned plants. These shoots of pruned plants were budded by high yielding varieties

NA-6 and NA-7 each on 05 plants respectively in June–July 2011. After successful emergence of scion bud, remaining side shoots of top worked plants were removed from budded stumps regularly. Shoots of remaining 05 un-budded plants were allowed to grow selectively to develop the proper framework of the plants. Judicious removal of growing shoots was followed to maintain varietal purity and vigor of plants. Growing shoots were again pruned in month of May 2012 up to 50 percent to develop multiple fruiting branches and structure of plants. Recommended IPNM package include application of 250 g Azotobactor + 50 kg FYM + 4 kg neem cake + 1000 g Nitrogen (In two split doses) + 500 gm potash and 750 gram phosphorus/ tree per year (Singh and Mishra 2007) were applied to all plants under the trial in Jan-Feb and June along with Multi micronutrient mixture. All the recommended production technique and plant protection measures were followed accordingly. Remaining unpruned plants of the orchard treated as (control) for the study. Details of treatments are mentioned as below.

T1 = Rejuvenation pruning followed by top working with Elite Varieties + IPNM package + recommended management practices.

T2 = Rejuvenation pruning + IPNM package + recommended management practices.

T3 = Traditional farmers practice (Application of DAP@ 300 per plant followed by irrigation).

Data were recorded on growth, quality and yield parameters of plants under study in every year just after shoot pruning and flowering and fruiting accordingly. Yield data were recorded by adding of all the pickings of a season in each treatment and averaged per tree accordingly. The observations on fruit analysis were taken in composite sample of 5 fruits collected from each treatment. Fruit size was recorded by measuring the length and breadth using Vernier calipers, while weight was taken using digital balance. TSS was measured with the help of Erma refractometer (0-32Brix). Per cent increase in yield was calculated by using following formula.

$$\text{Percent increase in yield} = \frac{\text{Yield of rejuvented plant - Farmer practice(Control)}}{\text{Farmers practice(Control)}} \times 100$$

$$\text{B.C Ratio} = \frac{\text{Gross return}}{\text{Cost of cultivatiob}} \times 100$$

RESULTS AND DISCUSSION

Data presented in table-1 revealed there is lacking of awareness among the farmers and other stakeholders involved in Aonla production in the district Ghazipur about recommended production technologies e.g. high yielding varieties, crop regulation, high density planting, nutrition management, mulching, intercropping, pruning response, use of bio-regulator and plant protection measures. (Das, B. 2014) The competitive intercrops i.e. rice, bitter gourd and pigeon pea along with imbalance nutrition management not only reduces the yield and canopy development of orchard but also induces the orchard decline due to higher incidence of diseases and pests.(Ravindra *et al* 2006)

Constraint experienced by farmers in adoption of rejuvenation technology summaries in table 02. Lack of knowledge and skill about management of overcrowded orchard and poor production management approach were the important causes

Table1: Technological gap between improved management packages and farmers practices

SN	Technologies	Farmers Practices	Improved managementPackage
1.	Selection of high yielding variety	Not aware, insist only grafted plants	Improved varieties i.e. Narendra Aonla-6, Narendra Aonla-7, Chakaiya
2.	Nutrient management	Application of chemical fertilizers at injudicious doses 300 gram DAP per plant	IPNM technology consisted 250 g Azoto bactor + 50 kg FYM + 4 kg neem cake + 1000 g Nitrogen (In two split doses) + 500 gm potash and 750 gram phos phorus/ tree per year.
3.	Mulching	Not aware	Mulching with paddy straw/ banana leaf or with black polythene
4.	Pruning and training	Not aware	Mild pruning in December in fruiting plants and rejuvenation of same orchard
5.	Selection of intercrop	Growing rice, wheat and bitter gourd ; causes garden decline	Okra, cowpea, dolichus and turmeric can be grow as intercrop in guava orchard synergistically
6.	Pest and disease management	Injudicious use of pesticides	Application of IPM technique of Aonla

Table 2 : Constraints experienced by farmers in adoption of rejuvenation technology

SN	Identified constraints
1	Lack of awareness and knowledge about rejuvenation technology
2	Un willingness about deep pruning in Aonla tree
3	Lack of faith in rejuvenation techniques and risk of survival of orchard after deep pruning
4	Fear of economic loss by missing two crops
5	Lack of risk taking willingness
6	Unavailability of skilled labour and equipments
7	Fear of forest law and police
8	Complexity of work

responsible to orchard decline. Fear of economic loss in resource poor farmers was another factor of non adoption of improved production technology. These facts were also in agreement with the findings of Singh *et al*. 2003.

The farming situation as given in table-3 favors the commercial growing of Aonla in the district. It consist of sandy loam soil with pH 7.5- 8.00, lower N & P with medium K_2O and sufficient rainfall which are suitable for Aonla production, but unmanaged, poorly nourished, overcrowded orchard taken under study were unable to produce higher yield and tend to become uneconomic.

EXPERIMENTAL ANALYSIS:

The experimental findings summarized in table-4 revealed that significantly and consistently profuse flowering were observed in T_1- (Rejuvenated trees followed by Top working + IPNM) than T_2- (Rejuvenated trees + IPNM) andT-3 farmers practice(Un pruned trees) .

This is because of increased branching complexity resulted in more fruiting shoots in young trees, promoting precautious flowering and fruiting (Campbell and Wasielewski, 2000). Observation recorded on vegetative growth revealed that the height of the plant of rejuvenated trees were for less than the farmer practices but emergence of new shoots were found highest in T1 than the T2 and T3. Pooled data on flowering shoots of different year indicated that Treatment (T1) had maximum fruiting shoots (48.66 per cent) in comparison to T2 (28.33 per cent) and farmers practice (T3) 15.66 per cent. It is very clear that consistent pruning responded well and stimulated new growth to convert in fruiting shoots. Similar findings were also reported by Baba *et al*.(2011) .The data related to yield in table-4 exhibited that T1- (Rejuvenated trees followed by top working with NA-6,NA-7 + IPNM) trees consistently and significantly produced higher yield (24.90 to 74.00 kg tree^{-1}) as the year passes over the farmers practice (27.00 to 28.80 kg tree^{-1}) except the 1st year of fruiting. However, the yield from T2 found consistently in increasing trend (25.50 to 39.14 kg tree^{-1}) but lower than T1- (Rejuvenated trees followed by top working with NA-6,NA-7 + IPNM). It is because of increased new growth in T2 due to management practices but less conversion of new shoots in bearing shoots than the T1 is perhaps because of indigenous character of local variety. Increased yield of Rejuvenated trees than the un pruned trees are due to rapid growth in canopy development within shorter period of after rejuvenation and reduced demand of nutrient for maintenance un necessary growing branches due to severe pruning. Application of balance dose of plant nutrients with better absorption by established root system of rootstock also favored prolific bearing on pruned branches which is converted in percent increase in average yield of three years period. It is reported highest in T1 (90.20 per cent) in comparison to T2 (44.80 per cent) over the farmers practice (T3). The fact is also supported by Singh *et al*. (2015).

The data pertaining to quality parameters revealed that size of fruits found maximum T1 followed by T2 in comparison to farmers practice T3).Similarly the average fruit weight recorded highest (25.60 g) in T1 followed by T2 (20.46 g) and T3 (18.33 g). (Mangesh *et al*.,2016) While regarding total soluble solids, it is observed that maximum 7.7% in fruits of T1 in comparison to T2 and T3 (6.3%). The quality of fruits obtained from top worked trees was observed significantly better than fruits obtained from seedling trees. The differences in qualitative characters may be due to varietal conversion of top worked plant, location of fruits and light distribution within canopy. It also indicated that even with proper following of Improved production technology, management of shoot within tree canopy is important for maintenance of fruit quality and production (Campbell and Wasielewski, 2000).Similar pattern on improved canopy growth, yield and fruit quality were also reported by Mistry and Patel (2009), Pathak *et al*. (1996)and Lal and Mishra (2008) in rejuvenation of different fruit crops.

ECONOMIC ANALYSIS:

Data related with economic impacts of the study listed in table-5. After conversion of yield in ha (277 plants/ha at 6x6 meter spacing) from per plant, economics of the study was calculated accordingly. Data revealed that the margin (net return) was very poor in rejuvenated plants (Rs. 57552/ha) in 2013 than the T2 (Rs. 77376/ha) and farmers practice T3 (Rs. 61748/ha). However, it found maximum in T1 *i*.e. Rs.156770/ha and Rs.219467/ha in ensuing years 2014 and 2015 respectively than the T2 (Rs.91704/ha and Rs.151264/ha) and T3 (Rs.57596/ha and Rs.67924/ha). The trend of negative net gain over farmers practice (Rs.-4196/ha) in rejuvenated plants followed by top working (T1) was reported due to increased cost of production in 2013. It is because of higher input cost of heavy pruning of plants followed by top working practices and better management practices. The B: C ratio was maximum in farmers practice (3.20) in initial year while it was too high in rejuvenated plants (5.77 and 9.60) followed by T2 (3.56 and 6.62) in comparison to control T3 (3.17 and 3.44) in the coming year 2014 and 2015 respectively. It might be suggested to farmers that the yield loss in first year due to rejuvenation technology, can be meet out by sale of pruned wood and better yield from intercrops in pruned orchard having more light and open space. Raising of intercrop like vegetables (potato, cucurbits, turmeric ..) fetched additional income about Rs.45000 to 55000/ha per year.

During the course of study (2011 to 2015) several field days and farmers visits were arranged at KVK PG College for the technological exposure to Aonla growers of the districts.

Growers with scientific temperament and entrepreneurial orientation appreciated the potential of technology and ready to adopt by having a refinement in technology by way of

Table 3: Details of farming situation of experiment on rejuvenation of Aonla

Experiment	Duration of study	Variety	Age of plant	Farming situation	Soil type	pH	Soil status N	P	K	Season rainfall	Avg. no. of rainy days
Assessment of Rejuvenation technology in Aonla	Dec 2010 to Nov. 2016	Locally produced seedling plants	15 years	Irrigated	Sandy loam	7.5-8.0	Low	Low	Medium	560 mm	29

Table 4: Effect of Top working and rejuvenation pruning along with nutrition management on growth, flowering and yield of Aonla Orchard

Treatment	Avg. tree height (m)	Emergence of new shoots (no.)	Flowering shoots in (%)	Yield in kg/tree Ist year	IInd year	IIIrd year	Avg. yield kg/tree	% incr ease in yield
T_1- Rejuvenated trees followed by top working with NA-6, NA-7 + IPNM	3.8	13.8	48.66	24.9	58.33	74	52.41	90.2
T_2- Rejuvenated trees + IPNM	4.3	11.03	28.33	25.5	38.33	53.6	39.14	44.8
T_3-Farmers practice(Un pruned plant)	8.4	7.15	15.66	27	25.3	28.8	27.03	-
Quality parameter								
Length Of fruit	Breadth Of fruit			Avg. fruit wt.(g)			TSS brix^{0})	
3.24	3.52			25.6			7.7	
3.06	3.1			20.46			6.3	
3.02	3.06			18.33			6.3	

Table 5: Economic impact of rejuvenation technology on Aonla production

SN	Year	Total yield (q/ha) (@ 277 trees/ha)			Avg. cost of inputs (Rs./ha)			Avg. gross of return (Rs./ha)*				
		T1	T2	T3	T1	T2	T3	T1 Yield	Pruned wood	Total	T2	T3
1	2013	68.97	70.63	74.79	53832	36000	28000	82764	28620	111384	84756 FALSE	89748
2	2014	161.57	106.17	70.08	33500	35700	26500	193404	-	193404	127404	84096
3	2015	204.98	148.47	79.77	25600	26900	27800	245967	-	245976	178164	95724

Table 5 : Continue..

Net return (Rs./ha)			Net gain over Farmers practice (Rs./ha)		B: C ratio		
T1	T2	T3	T1	T2	T1	T2	T3
57552	77376	61748	-4196	15628	2.07	3.14	3.2
157704	91704	57596	109308	69808	5.77	3.56	3.17
219467	151264	67924	150243	82440	9.6	6.62	3.44

alternate row pruning. Farmers also appreciated the better management practice followed in T2 as well. It may be concluded that the success of this technique largely depends upon the proper management of shoots through precise and timely pruning

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