Evaluate the effect of Integrated Nutrient Management (INM) on Economic and Physical attributes of Aonla (*Emblica officinalis* Gaerten).

Abstract:

The present investigation was conducted Evaluate the effect of Integrated Nutrient Management on Economic and Physical attributes of Aonla (Emblica officinalis Gaerten).The research was carried at Main Experiment Station, Horticulture, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.) during the year 2021. It was laid out in a Randomized Block Design with 10 treatments namely: T_1 – Control, T_2- RDF 100% (1kg.N: 0.5kg.P:1kg.K per tree), T_3- FYM (10kg./tree) + RDF 100%, T_4- Poultry Manure (7.5kg./tree) + RDF 100%, T_5- FYM (10kg./tree) + RDF 50% + Azospirillium (10ml./tree), T_6- Poultry Manure (7.5kg/tree) + RDF 50% + Azospirillium (10ml./tree), T_7 -FYM (10kg./tree) + RDF 50% + PSB (10ml./tree), T_8- Poultry Manure + RDF 50% + Azospirillium (10ml./tree), T_9 –FYM (10kg/tree) + RDF 50% + Azospirillium (10ml./tree) + PSB (10ml./tree) and T_{10}- Poultry Manure (7.5kg/tree) + RDF 50% + Azospirillium (10ml/tree) + PSB (10ml./tree). The experiment was replicated thrice. Results showed treatment T_{10}- Poultry Manure (7.5kg/tree) + RDF 50% + Azospirillium (10ml/tree) + PSB (10ml. /tree) outperformed the rest with maximum fruit set percent (78.56%), fruit retention (20.29%), Fruit Yield (102.78 kg/tree), 1 Fruit Weight (41.89 g), Fruit length (3.87 cm), Specific gravity (1.05 g/cm3) and maximum Gross return/ha Rs. 128264, 3 Net return Rs 92154 and Cost: benefit ratio was evaluated with the use of Treatment combination T_{10}. Thus the treatment combination is therefore recommended for application to Aonla trees in Eastern Uttar Pradesh in order to obtain high yields with better quality fruits.

Key word: INM, Aonla, Physical Quality, Azospirillium.

Introduction:

The Indian gooseberry or aonla (Emblica officinalis Gaerten) belongs to family "Euphorbiaceae" with the chromosome number 2n=28. It is native of Indo- China, particularly in central and southern India. Aonla finds mention in 'Vedas, Ramayana, Charak Samhita and other ancient Indian Literature describing its fruit highly valuable as food, medicine and hair dye **(Anon, 1964, chopra et al., 1958)**. In India Aonla cultivation is done mainly in northwest Himalayas (J & K, Himachal Pradesh, and Uttrakhand) to eastern Himalayas (Assam, Manipur, Meghalaya, Mizoram and Tripura). The domestication of aonla was first started in Varanasi, Uttar Pradesh with the initiative of Maharaja of Kashi. Banarasi, a superior genotype was selected from the wild aonla trees available in large number in the nearby Vindhyan hills. Authentic information regarding its cultivation dates back to 1881-82 in the Pratapgarh district of Uttar Pradesh. The ailing state owner of the district (King) was advised for regular consumption of aonla fruits **(Singh et al., 2019).**

It is commercially cultivated in Uttar Pradesh, Uttrakhand, Gujarat, Maharashtra, Rajasthan, Tamilnadu, Andhra Pradesh, Karnataka, Bihar, Haryana, Madhya Pradesh and west Bengal. In Uttar Pradesh Aonla more cultivated in nearby the belt of Pratapgarh fallowed by Ayodhya

district. Area under aonla orchard in Pratapgarh district is about 1300 hectares. Whereas, the area in Sadder block of district of Pratapgarh approximately 3250 hectares **(Rai et al., 2017)**

Aonla is a subtropical plant and prefers dry subtropical climate but it can be successfully cultivated in wide range of soil and climatic condition. Aonla is a medium sized, much- branched tree occupying height of 10-20 m. Inflorescence is racemose type, flower minute, unisexual with short pedicel. It is richest sources of vitamin C (400-1300mg. /100g. fruit pulp) among the fruits next to Barbados cherry. Its fruit also contains 82.2% water, 0.5% protein, 0.1% fat, 14% Carbohydrate, calcium, phosphorous and iron. Aonla having a nutritional and medicinal value. Aonla is accepted hair tonic in traditional recipe for enriching hair growth and hair pigmentation. It is an important ingredient of Triphala and Chawanprash in Ayurvedic Medicine System. Beside fruits are commonly used for preparation of preserve (murabba), pickle, candy, jelly etc. It can be dried and powdered to be used subsequently. The soils of India and especially of arid and semi-arid regions are impoverished and hungry to plant nutrients. Considering economy, energy and environment, it is imperative that nutrients are to be used effectively by adopting the appropriate doses of nutrients to be applied, their placement and correct timings to ensured higher yields and to sustain the available nutrients in soil at the optimum level efficient nutrient management not only help in increasing the present fruits and vegetables production level but also sustained the fruit production and protect the environment from different types of hazards occurring due to misuses of costly fertilizers. Integrated nutrient management practices will help to increase the productivity of the crop and enrich the biota of soil **(Sharma et al., 2018**). It involves proper combination of chemical fertilizer, organic manures and bio fertilizers suitable to the system of land use and ecological, social and economic conditions.

Method & Material:

The present investigation was carried out at Main Experiment Station, Horticulture, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.) during the year 2021-2022. The experiment was laid out in Randomized Block Design with 10 treatments namely: $\mathbf{T_1}$Control,$\mathbf{T_2}$ RDF 100% (1kg.N: 0.5kg.P:1kg.K per tree), $\mathbf{T_3}$ FYM (10kg./tree) + RDF 100%, $\mathbf{T_4}$ Poultry Manure (7.5kg./tree) + RDF 100%, $\mathbf{T_5}$ FYM (10kg./tree) + RDF50% + *Azospirillium* (10ml./tree), $\mathbf{T_6}$ Poultry Manure (7.5kg/tree) + RDF 50% + *Azospirillium* (10ml./tree), $\mathbf{T_7}$ FYM (10kg./tree) + RDF 50% + PSB (10ml./tree),$\mathbf{T_8}$ Poultry Manure (7.5kg/tree) + RDF 50% + PSB (10ml./tree), $\mathbf{T_9}$ FYM (10kg/tree) + RDF 50% + *Azospirillium* (10ml./tree) + PSB (10ml./tree), and $\mathbf{T_{10}}$ Poultry Manure (7.5kg/tree) + RDF 50% + *Azospirillium* + (10ml/tree) + PSB (10ml./tree) replicated thrice. The Ayodhya district's climate is classified as semi-arid, with three distinct seasons: rainy or wet, winter, and summer or hot. The rainy season begins the last week of June and lasts until September or even into October, with 1200 mm of rain on average. The soil was identified as a sandy loam with an average pH of 7.71 and an average proportion of fine sand (64.77%), silt (22.76%), and clay (14.95%). Thirty-six year old plants were used in the experiment. The prescribed schedule for the Aonla plantation was followed for the usual cultural operations, plant protection measures, and basal application of manures and fertilizers. Data was collect on fruit set (%), Fruit retention (%), and Fruit yield kg/plant), Fruit weight (g/fruit), Fruit size (cm), fruit volume and specific gravity and cost: benefit ratio. The data obtained during experimentation were statistically analysed as per the method given by **Panse and Sukhatme (1985).**

Result and Discussion:

Effect of INM on different physical attributes and economic of aonla:-_

Fruit Set (%):

The data significantly presented in Table 1 revealed that maximum fruit set percent (78.56%) was noticed with the use of treatment T_{10} –Poultry Manure (7.5 kg/tree) + RDF 50% + Azospirillum (10 ml/tree) + PSB (10 ml/tree) followed with the use of T9- FYM (10 kg/tree) + RDF 50% + Azospirillum (10 ml/tree) + PSB (10 ml/tree). However minimum fruit set value (55.71%) was recorded with the use of T_1-control which was at par with T5-FYM (10 kg/tree) + RDF 50% + Azospirillum (10 ml/tree), T6- Poultry Manure (7.5 kg/tree) + RDF 50% + Azospirillum (10 ml/tree) and T7- FYM (10 kg/tree) + RDF 50% + PSB (10 ml/tree).

Fruit Retention (%):

It is apparent from Table.1treatment T_{10}-Poultry Manure (7.5kg/ tree) + RDF 50% + Azospirillium (10 ml/tree) + PSB (10 ml/tree) recorded significantly maximum number of fruit retention was obtained (20.29%) fallowed with the use of T_9-FYM (10 kg/tree) + RDF 50% + Azospirillum (10 ml/tree) + PSB (10 ml/tree). Whereas, the minimum fruit retention (12.23) percent was observed in treatment T1 (control) which was statistically at par with T2-RDF 100% (1kgN: 0.5kgP:1kgK per tree) and T_3- FYM (10 kg/tree) + RDF 100%. The results are in conformed with the findings of **Hiwale (2009) and Prabhu et al. (2018).**

Table: 1 Physical attributes

	Treatments	Fruit Set (%)	Fruit Retention (%)	Fruit Yield (kg/tree)	Fruit Weight (g)	Fruit Length (cm)	Fruit Width (cm)
T_1	Control	55.71	12.23	54.97	37.14	3.10	3.32
T_2	RDF 100 % (1kg N : 0.5kg P : 1kg K per tree)	57.53	13.98	68.15	38.90	3.18	3.45
T_3	FYM (10kg/tree) + RDF 100%	59.66	15.55	73.46	39.17	3.30	3.50
T_4	Poultry manure (7.5kg/tree) + RDF 100%	62.20	15.99	77.05	39.27	3.40	3.52
T_5	FYM (10kg/tree) + RDF50% + *Azospirillium* (10ml/tree)	66.10	16.80	82.15	39.98	3.42	3.57
T_6	Poultry manure (7.5kg/tree) + RDF 50% + *Azospirillium* (10ml/ tree)	70.06	17.80	85.08	40.06	3.46	3.62
T_7	FYM (10kg/tree) + RDF 50% + PSB (10ml/tree)	73.16	18.0	90.02	40.87	3.60	3.70
T_8	Poultry manure + RDF 50% + PSB (10ml/tree)	74.73	18.90	93.13	41.24	3.65	3.90

T_9	FYM + RDF 50% + *Azospirillium* (10ml/tree) + PSB (10ml/ tree)	76.13	19.50	96.09	41.38	3.69	4.00
T_{10}	Poultry manure (7.5kg/tree) + RDF 50% + *Azospirillum* (10ml/ tree) + PSB (10ml/tree)	78.56	20.29	102.78	41.89	3.87	4.15
	SEm ±	0.77	0.36	1.27	0.68	.04	0.06
	CD at 5%	2.22	1.07	**3.76**	2.02	0.11	0.17

Fruit Yield (kg/tree):

Data presented in Table.1 clearly indicated that application of Poultry Manure (10kg/tree) + RDF 50% + Azospirillum (10ml./tree) + PSB (10ml./tree) was found to be significantly best treatment and maximum fruit yield obtained 129.79 kg per tree followed by FYM (10kg/tree) +RDF 50% + Azospirillum (10ml./tree) + PSB (10ml./tree). Whereas, minimum fruit yield obtained 72.95 kg per tree in treatment (control). The present findings are in conformity with report of **Amiri and Fallahi (2009), Bhabiskar et al. (2011), Aiyelaagbe et al. (2012) and Ghosh et al. (2012**).

Fruit Weight (g):

The significantly maximum fruit weight (41.89 g) was recorded in the treatment T_{10}- Poultry Manure (7.5kg/ tree) + RDF 50% + Azospirillum (10ml. /tree) + PSB (10ml. /tree) fallowed by treatment T9- FYM (10kg/tree) + RDF 50% + Azospirillum (10ml. /tree) +PSB (10ml./tree). Whereas, treatment T_1 that is control indicated minimum average fruit weight (37.14 g) and application of T_8, T_7 and T_6 were found to at par with T_{10} and proved equally good to increase fruit weight. This type of result are in close conformity with (1125:750:375 g NPK + 15 kg vermicompost + 250 g Azotobactor + 250 g PSB/plant) in sapota **Bhabiskar et al. (2011), Manjunath et al.,(2006) Bendegumbal et al., (2008)** and also reported by **Aal et al. (2020).**

Fruit Length (cm):

Fruit length has clearly presented in Table 1 revealed that the response of- Poultry Manure (7.5kg/ tree) + RDF 50% + Azospirillium (10ml. /tree) + PSB (10ml. /tree). The significantly higher fruit length was recorded with treatment T_{10} Poultry Manure (7.5kg/ tree) + RDF 50% + Azospirillium (10ml./tree) + PSB (10ml./tree) and value was obtained (3.87cm) fallowed by T_9- - FYM (10kg/tree) + RDF 50% + Azospirillium (10ml./tree) +PSB (10ml./tree) which was at par with T8 and T_7. However the minimum fruit length (3.10cm) observed with treatment T_1 i.e. Control. Bhabiskar et al. (2011) reported maximum fruit size treated with (1125:750:375 g NPK + 15 kg vermicompost + 250 g Azotobactor + 250 g PSB/plant).

Fruit Width (cm):

It is evident from the data presented in Table 1 that application of integrated nutrient management significantly influenced the fruit width and in T_{10} treatment recording maximum fruit width value obtained (4.15 cm) and it was followed by T_{10}. However treatment T_{10} indicated minimum fruit width value (3.32 cm) which was statistically at par with T2 and T3. **Bhabiskar et al. (2011)** reported maximum fruit size treated with (1125:750:375 g NPK + 15

kg vermicompost + 250 g Azotobactor + 250 g PSB/plant) and similar result also reported by Aal et al. (2020) with the application of 50% RDF through chemical fertilizer + 25% RDN through vermicompost + 10 ml. Anubhav bio NPK consortion/tree).

Specific gravity (g/cm3):

The maximum specific gravity value (1.05g /cm3) was recorded with the use of T_{10} followed by T_9. However T_{10} was at par with treatment T_8, T_7, T_3 and T_2 whereas minimum specific gravity value (1.01g/cm3) was recorded with the treatment T_1 that is control. This type finding conformity with by **Rayees et al. (2015)** revealed that application of various treatment combinations of organic and inorganic fertilizers in strawberry (*Fragaria x annanassa* Duch.) was observed maximum specific gravity.

Economics attributes:

Cost of production:

Data pertaining in Table 2 that cost of production varied as variation in different treatments. Maximum total cost of production was noted with the use of T_{10} Poultry Manure (7.5kg/tree) + RDF 50% + Azospirillium (10ml/tree) + PSB (10ml./tree) followed by application of T_9 FYM (10kg/tree) + RDF 50% + Azospirillium (10ml./tree) + PSB (10ml./tree).

Gross return:

The highest gross return/ha Rs. 128264 were recorded with the use of T_{10}. The lowest gross return/ha Rs. 68584 with the application of T_1.

Net return:

Data pertaining in Table 2 revealed that the Maximum net returns obtained with the application of T_{10} Poultry Manure (7.5kg/tree) + RDF 50% + Azospirillium (10ml/tree) + PSB (10ml. /tree).

Cost: benefit ratio:

Data pertaining in Table 2 revealed that the Maximum benefit ratio obtained with the application of T_{10} Poultry Manure (7.5kg/tree) + RDF 50% + Azospirillium (10ml/tree) + PSB (10ml. /tree). These types of results were noted by Kumar et al. (2018) in strawberry with the combined application with organic manures and also reported by **Srivastava et al. (2014)**

Table: 2 Economics of different INM during present investigation:

	Treatments	Yield (q/ha.)	Cost of production (Rs. /ha.)	Gross income (Rs./ha.)	Net income (Rs./ha.)	Cost: benefit ratio
T_1	Control	99.74	26650	68584	41394	1:1.57
T_2	RDF 100 % (1kg N : 0.5kg P : 1kg K per tree)	106.31	30753	85048	54295	1:1.76
T_3	FYM (10kg/tree) + RDF 100%	114.59	31450	97672	60222	1:1.91
T_4	Poultry manure (7.5kg/tree) +	120.19	32120	96152	64032	1:1.99

	RDF 100%					
T_5	FYM (10kg/tree) + RDF50% + *Azospirillium* (10ml/tree)	128.54	32990	102832	69842	1:2.11
T_6	Poultry manure (7.5kg/tree) + RDF 50% + *Azospirillium* (10ml/ tree)	132.74	33210	106176	72966	1:2.19
T_7	FYM (10kg/tree) + RDF 50% + PSB (10ml/tree)	140.43	34340	112344	78004	1:2.27
T_8	Poultry manure + RDF 50% + PSB (10ml/tree)	145.28	34995	116224	81229	1:2.32
T_9	FYM + RDF 50% + *Azospirillium* (10ml/tree) + PSB (10ml/ tree)	149.90	35650	119920	84270	1:2.36
T_{10}	Poultry manure (7.5kg/tree) + RDF 50% + *Azospirillum* (10ml/ tree) + PSB (10ml/tree)	160.33	36110	128264	92154	1:2.55

Conclusion:

In this way experiment was revealed that the maximum Physical and Economical attributes viz., Fruit Set % , : Fruit Retention (%),Fruit Yield (kg/tree), Fruit Weight (g), : Fruit Width (cm),and Cost: benefit ratio were obtained with the application of Poultry manure (7.5kg/tree) + RDF 50% + *Azospirillum* (10ml/ tree) + PSB (10ml/tree)

Future Scope:

INM is a system that helps to restore and sustain crop productivity and also assist in checking the emerging micro-nutrient deficiencies. With this view a dire need as felt and thought importance to minimize the use of chemical fertilizers with the use of integrated nutrient management towards better growth, yield of fruits.

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