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Integrated nutrient management in aonla cv. A-7 in the red lateritic region of West Bengal

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ABSTRACT

An experiment was carried out at the Regional Research Sub-Station Sekhampur of Bidhan Chandra Krishi Viswavidyalaya, West Bengal, India for two consecutive years during 2008-09 to 2009-10 on to study the effect of integrated nutrient management on growth and yield of aonla cv. NA-7. Observations on plant morphological characters and yield attributes were recorded at maturity of 3 years old aonla trees. The highest plant height (323.00cm) was recorded in trees supplied with 100: 25:150 g NPK + 10kg FYM+ 50g PSB plant^{-1}. The highest number of branches was noted in 100:25:150 G NPK + 10KG FYM + 50G PSB plant^{-1} treatment (15.30) and the lowest number of branches could be noted against the 100:50:150 g NPK plant^{-1} treatment (9.53) consisting of exclusive application of inorganic fertilizers. The highest number of fruits was observed in 100:25:150 g NPK + 5kg vermicompost + 50g PSB plant^{-1} (73.17) which was closely followed by 100:25:150 g NPK + 10kg FYM + 50g PSB plant^{-1} treatment (72.73). The highest yield was recorded in 100:25:150 G NPK + 10KG FYM + 50G PSB plant^{-1} (1781.43 g plant^{-1}) whereas lowest fruit yield was recorded in 100:50:150 g NPK plant^{-1} (831.96 g/plant). In general, the treatment comprising of integration of inorganics, organics and bio-fertilizers produced 50.92% more yield than the application of inorganic fertilizers only (100:50:150 g NPK plant^{-1}treatment). It appears from the investigation that application of 100: 25:150 g NPK plant^{-1}+ 10kg FYM+ 50g PSB plant^{-1}and 100:25:150 g NPK + 10kg FYM + 50g PSB plant^{-1}) treatments are beneficial for increasing vegetative growth as well as improving yield and yield attributing characters of aonla cv. NA-7 under red and lateritic region of West Bengal

Keywords**:** Aonla, integrated nutrient management, yield

Aonla (*Phyllanthus emblica* L.) belongs to the family Euphorbiaceae, is one of the important minor fruit crops in our country. The edible fruit is highly nutritious and is the richest source of vitamin **–**C (400-1300mg 100^{-1} g fruit pulp) among the fruits next to Barbados cherry (Asenjo, 1953). Soil type, fertility and nutrient management play important roles in obtaining higher growth and yields of aonla. Lateritic soils are poor in organic carbon medium in potassium, low in nitrogen and phosphorus. Now a days cost of inorganic fertilizers are gradually increasing. Indiscriminate use of chemical fertilizers, pesticides, weedicides etc. over the last four decades had adversely affected the soil fertility, water quality, yield and quality of the produce and increased level of resistance in pests (Kalloo, 2003). To maintain soil health of poor lateritic soils more emphasis should be given on organic nutrients for better soil health and improved production. Due to poor physical properties of soil it becomes very hard during dry season and crops suffer due to deficiency of major plant nutrients. With the discovery of an aerobic N-fixer clostridium and nonsymbiotic free living aerobic organism *Azotobacter* and *Azospirillum,* it was made possible to sustain productivity of different non-legumes under normal pressure of oxygen (Ray *et al*., 2007).

No systematic studies have been made so far to determine the requirement of manures and fertilizers in an integrated manner for aonla in the state of West Bengal. Hence, the present investigation was undertaken to study the effect of different organic and biofertilizers in combination with chemical fertilizers for higher growth and return.

MATERIALS AND METHODS

A field trial was conducted for two years during 2008-2009 and 2009-2010 on 3 years old aonla trees at the Regional Research Sub-Station of Bidhan Chandra Krishi Viswavidyalaya, Sekhampur, Birbhum, West Bengal. The trial was laid out in a Randomized Block Design with ten treatments (Table 1) and each treatment was replicated thrice. Observations on plant morphological characters e.g., plant height, plant girth, number of branches (primary and secondary) per plant, plant spread (north-south and east-west direction) and yield attributes like number of fruits per plant, fruit yield per plant, fruit weight, fruit length, fruit breadth, pulp weight seed weight and pulp to seed ratio were recorded at harvest maturity. The experimental data were analyzed statistically following the analysis of variance method given by Panse and Sukhatme (1985) and pooled data were presented in the tables for discussion.

RESULTS AND DISCUSSION

The data with respect to growth attributes like plant height, plant girth, number of branches (primary and secondary)per plant, plant spread

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(north-south and east-west direction) as influenced by inorganic and integration of bio-resource supplements. There was statistically significant difference between the treatments on account of the growth attributes of aonla (Table-1). The plants were tallest due to the application of the 100:25:150 g NPK + 10kg FYM + 50G PSB plant^{-1} treatment (323cm), although the 100:25:150 g NPK + 50g PSB + 40g *Azotobactor* plant^{-1} (318.43cm), 100:25:150 g NPK + 10kg FYM + 50g PSB + 40g *Azotobactor* plant^{-1} (314.75cm), 100:50:150 g NPK + 40g *Azotobactor* plant^{-1} (314.70cm) and 100:25:150 g NPK + 50g PSB plant^{-1} (305.33cm) treatments attained statistically similar heights. The lowest height of 238.60cm was recorded in the 100:50:150 g NPK plant^{-1} treatment. The 100:25:150 g NPK + 10kg FYM + 50g PSB plant^{-1}treatment (5.37cm) was instrumental in augmenting the maximum girth of aonla plants followed by 100:25:150 g NPK + 50g PSB + 40g *Azotobactor* plant^{-1} (5.33cm) and 50:25:150 g NPK + 10kg FYM + 50g PSB + 40g *Azotobactor* plant^{-1} (5.20cm) treatments. The maximum number of branches per plant was registered in the 100:25:150 g NPK + 10kg FYM + 50G PSB plant^{-1}treatment (15.30) which was statistically higher than the other treatments. The lowest number of branches could be noted against the 100:50:150 g NPK per plant treatment (9.53) consisting of exclusive application of inorganic fertilizers.

Table 1: Effect of inorganic, organic and bio-fertilizers on growth attributes of aonla (mean of 2 years)

Treatments	Height (cm)	Girth (cm)	Branches plant^{-1}	Plant spread N-S (cm)	Plant spread E-W (cm)
T_1:100: 50:150g NPK plant^{-1}	238.60	2.88	9.53	200.00	195.20
T_2: T_1+10kg FYM plant^{-1}	247.33	3.23	11.70	206.30	221.03
T_3: T_1+5kg vermicompost plant^{-1}	256.20	3.50	11.80	205.20	212.53
T_4:100: 25:150 g NPK+50g PSB plant^{-1}	305.33	3.77	12.00	228.60	223.70
T_5: T_1+40g *Azotobactor* plant^{-1}	314.70	4.53	12.80	221.33	224.27
T_6: T_4+ 40g *Azotobactor* plant^{-1}	318.43	5.33	13.00	300.63	297.33
T_7: T_4+10kg FYM	323.00	5.37	15.30	281.40	245.53
T_8: T_4+5kg vermicompost	314.75	4.80	13.20	250.23	262.30
T_9:50: 25:150 g NPK+10kg FYM +50g PSB+40g *Azotobactor* plant^{-1}	264.67	5.20	12.60	221.57	214.17
T_{10}:50: 25:150 g NPK+5kg vermicompost +50g PSB+ 40g *Azotobactor* plant^{-1}	258.33	4.88	12.90	237.73	242.80
SEm (±)	**16.78**	**0.33**	**1.25**	**21.11**	**21.32**
LSD (0.05)	**35.24**	**0.69**	**2.64**	**44.33**	**44.33**

The highest plant spread in North- South direction was obtained with the 100:25:150 g NPK + 50g PSB + 40g *Azotobactor* plant^{-1} treatment (300.63cm) followed by the 100:25:150 g NPK + 10kg FYM + 50G PSB plant^{-1}treatment (281.40cm). The other integrated treatments had more or less statistically similar values of plant spread in North-South direction. Comparing the plant spread in the East-West direction as measured against the different treatments it could be observed that the highest values were in the 100:25:150 g NPK + 50g PSB + 40g *Azotobactor* plant^{-1}treatment (297.33cm) and 100:25:150 g NPK + 10kh FYM + 50g PSB + 40g *Azotobactor* plant^{-1} (262.30cm), both being statistically similar. The lowest plant spread in both the directions was noted in the exclusive fertilizer treatment 100:50:150g NPK plant^{-1}. It is reported that biofertilizers that of *Azospirillium*, *azotobactor sp*. and *Pseudomonas* sp., which are known to fix atmospheric N2 improves vegetative growth by benefiting host plants through supply of growth hormones and vitamins (Shaban and Mohsen, 2009).

Considering the yield attributes of aonla, varied responses between the different treatments could be noted (Table-2). Observations recorded in respect of number of fruits per plant, clearly shows the 100:25:150 g NPK + 10kg FYM + 50g PSB + 40G *Azotobactor* plant^{-1}treatment (73.17) surpassing the other treatment, although being statistically similar to the 100:25:150 g NPK + 10kg FYM + 50g PSB plant^{-1}treatment (72.73). The 100:50:150 g NPK/plant treatments produced the lowest number of fruits per plant (35.10). On an average, integrated application of inorganic, organic and biofertilizers to aonla produced 36 and 89% more number of fruits per plant than integration of either FYM or vermicompost with inorganic or with exclusive inorganic fertilizers respectively. The 100:25:150 g

NPK + 10kg FYM + 50g PSB plant^{-1} treatment (1781 g plant^{-1}) significantly manifested the highest yield followed by 100:25:150 g NPK + 10kg FYM + 50g PSB + 40g *Azotobacter* plant^{-1} treatment (1583.38 g plant^{-1}). In general, the treatment comprising of integration of inorganics, organics and biofertilizers produced 50.92% more yield than the application of inorganic fertilizers only (100:50:150 G NPK plant^{-1} treatment). The integration of all the inorganic and organic sources including biofertilizers augmented the yield of aonla by 39.79% over the treatments comprising of inorganic and organic manures *i.e.* FYM or vermicompost. There was, on an average 25% increased in the yield of aonla with integrated application of inorganic and organic manures than the application of inorganic fertilizers exclusively. The present results are in agreement with Korwar *et al.* (2006). Regarding the weight of fruit the treatment 100:25:150 g NPK + 10kg FYM + 50g PSB plant^{-1} (24.80g) and 100:25:150 g NPK + 50g PSB + 40g *Azotobacter* plant^{-1} (22.90g), being statistically significant than the other treatments.

Table 2: Effect of inorganic, organic and bio-fertilizers on yield attributes of aonla (mean of 2 years)

Treatments	Fruits plant^{-1}	Yield plant^{-1} (g)	Weight fruit^{-1} (g)	Length fruit^{-1} (cm)	Breadth fruit^{-1} (cm)	Pulp weight fruit^{-1} (g)	Seed weight fruit^{-1} (g)	Pulp:seed fruit^{-1}
T_1	35.10	831.96	18.93	2.80	3.10	17.70	1.70	10.41
T_2	49.47	1076.69	22.23	3.00	3.20	17.90	1.67	10.71
T_3	47.90	1013.09	22.20	3.10	3.50	20.90	1.70	12.29
T_4	46.43	948.92	20.40	2.90	3.30	18.80	1.80	10.44
T_5	50.00	974.92	19.50	2.90	3.10	17.60	1.70	10.35
T_6	62.80	1439.94	22.90	3.40	3.60	21.00	1.77	11.86
T_7	72.73	1781.43	24.80	3.60	3.30	22.60	1.93	11.70
T_8	73.17	1583.38	21.00	3.20	3.50	19.50	1.80	10.85
T_9	59.67	1217.22	20.47	3.10	3.40	18.70	1.70	11.00
T_{10}	60.70	1257.51	20.70	3.20	3.50	18.90	1.83	10.32
SEm (±)	**4.68**	**111.87**	**1.19**	**0.17**	**0.19**	**0.80**	**0.18**	**-**
LSD (0.05)	**9.84**	**234.92**	**2.51**	**0.36**	**0.40**	**1.69**	**NS**	**-**

The 100:25:150 g NPK + 50g PSB + 40g *Azotobacter* plant^{-1}treatment (3.60cm) showed the highest breadth per fruit followed by 100:25:150 g NPK + 10kg FYM + 50g PSB + 40g *Azotobacter* plant^{-1} (3.60 cm), 100:50:150 g NPK plant^{-1}+ 5kg vermicompost plant^{-1}, and 50:25:150 g NPK + 5kg vermicompost + 50g PSB + 40g *Azotobacter* plant^{-1} (3.50cm), 50:25:150 g NPK + 10kg FYM + 50g PSB + 40g *Azotobacter* plant^{-1} (3.40cm), 100:25:150 g NPK + 10kg FYM + 50g PSB plant^{-1} and 100:25:150 g NPK + 50g PSB plant^{-1} (3.30cm) and 100:50:150 g NPK plant^{-1}+ 10kg FYM plant^{-1} (3.20cm). The pulp weight of aonla fruit due to different treatments varied from 17.70g to 22.60g with the highest recorded against the 100:25:150 g NPK + 10kg FYM + 50g PSB plant^{-1} (22.60g) treatment and the lowest in the 100:50:150 g NPK plant^{-1} (17.70g) treatment. With regards to pulp: seed ratio the values were in the range of 10.32 to 12.29 against the different treatments.

It appears from the investigation that application of 100: 25:150 g NPK plant^{-1}+ 10kg FYM+ 50g PSB plant^{-1} is beneficial for increasing vegetative growth as well as improving yield and yield attributing characters of aonla cv. NA-7 under red and literate region of West Bengal.

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