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Performance of bioinoculant, urea and cowdung on growth, nodulation and biomass yield of akashmoni (*Acacia auriculiformis*) in old Bramaputra floodplain soil

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Abstract: To study the response of bioinoculant, urea and cowdung in Old Bramaputra Floodpalin soil on growth, nodulation and biomass yield of Akashmoni (*Acacia auriculiformis)* sapling a pot experiment was conducted during February to May, 2007 at Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh. There were 7 treatments of bioinoculant and fertilizers viz. Mixed inoculant (I_m), Mixed inoculant + Nitroggen @ of 30 kg/ha (I_mN_{30}), Mixed inoculant + Cowdung @ 30 t/ha (I_mCD_{30}), Nitrogen @ 30 kg/ha (N_{30}), Cowdung @ 30 t/ha (CD_{30}), Mixed inoculant + Nitrogen @ 30 kg/ha + Cowdung ($I_mN_{30}CD_{30}$) and uninoculated Old Bramaputra Floodpalin soil as control (I_o). The experiment was laid out in split-plot design using bioinoculant and other fertilizers in sub plots and soils in main plots with three replications. Inoculation with bradyrhizobial inoculant, nitrogen fertilizer and cowdung was done at time of transplanting of seeding. The plants were harvested at 60 days after transplanting for collection of datas of various plant parameters. Data revealed that bioinoculant performed significantly better in nodulation, nodule dry weight, leaf number, leaf fresh weight, leaf dry weight, shoot height, shoot fresh weight, shoot dry weight, root fresh weight and root dry weight compared to uninoculated Old Bramaputra Floodpalin soil. Treatment $I_mN_{30}CD_{30}$ resulted the highest in nodule number as well as other plant parameters. I_mCD_{30} produced superior plant characters i.e. nodule number, shoot height, root fresh weight and root dry weight compared to the rest treatment I_mN_{30}, $CD30$, I_m, N_{30} and control. Bionoculant treatment gave better result than N_{30}, CD_{30}, and control. Treatment $I_mN_{30}CD_{30}$ was found to be the best treatment in the study and I_mCD_{30} was proved as cost effective and environment friendly for Akashmoni cultivation. Therefore, mixed inoculant along with cowdung 30 t/ha (I_mCD_{30}) can be used for production of Akashmoni sapling in the nursery in Old Bramaputra Floodpalin soil.

Key words: Bioinoculant, nodulation, biomass yield, akashmoni, old bramaputra floodpalin soil.

Introduction

Akashmoni (*Acacia auriculiformis)* is fast growing middle sized nitrogen fixing evergreen exotic forest plant belonging to the sub family Mimosoideae under the family Leguminosae. It is an Australian native species introduced in Bangaldesh. The exact date and time is still unknown when the akashmoni tree has been introduced in Bangladesh. However, it is known that its initial introduction was by a British tea manager in Sylhet area about 30 years ago. This tree grows well in high hill to floodplains or even drought prone less fertile soil having a wide range of pH (3 - 9.5), withstands adverse and wide range of environmental conditions. Soon it became very popular to the farmers because of its wide range of adaptability. During the last few decades tree plantation and a few concept of agroforestry practices become popular and significant throughout the country due to environmental concern, economical importance and for the question of sustainable farming system as a whole. akashmoni as a tree species is very popular among the farmers either in tree-plantation programme or in some sort of informal agroforestry practices due to its distinguished features. Now a day, akashmoni is found in road side, homestead, farmer's field and orchard, throughout the country. The seedling grown in the same year can be used in forest plantations due to its fast growing nature and can be established successfully in cattle disturbed situations as it is neither grazed nor browsed. The timber of tree is moderately hard, excellent in texture and grain can be compared with that of teak. Total biomass production of akashmoni is very high equivalent to 16.94 t h^{-1}(Kumar *et al.,* 2001). The vegetation cover increased more nutrient cycling and biological nitrogen fixation than before. Biological nitrogen fixation is friendly to environment which reduces the use of nitrogenous chemical fertilizer. Biofertilizer can be used instead of nitrogenous chemical fertilizer. It is environmentally safe, cost effective and moreover if once it is used it will be working for the time continuously. *Bradyrhizobium* is reported as a nitrogen fixer in legume plants. Cowdung supplies nitrogen, organic matter and other nutrients in a trace amount. Urea is a commonly used nitrogenous fertilizer in Bangladesh. Biological nitrogen fixation is influenced by soil properties considerably specially by soil pH and organic matter content. However, not much research work has been done on the effect of inoculants, cowdung, urea and their combined effect on Akashmoni in different agro-ecological region of Bangladesh. Therefore, the present research work was undertaken to observe the performance of inoculant, cowdung, urea and different combination of inoculant along with cowdung and urea on the growth, nodulation and bio-mass production of Akashmoni in Madhupur soil and to select the most effective treatment combination in soil for the recommendation of Akashmoni cultivation.

Materials and Methods

The pot experiment was conducted during February to May, 2007 at Bangladesh Institute of Nuclear Agriculture(BINA), Mymensingh to study the response of bioinoculant, urea and cowdung in Madhupur soil on growth, nodulation and biomass yield of Akashmoni (*Acacia auriculiformis)* sapling. There were 7 treatments of bioinoculant and fertilizers viz. Mixed inoculant (I_m), Mixed inoculant + Nitroggen @ of 30 kg/ha (I_mN_{30}), Mixed inoculant + Cowdung @ 30 t/ha (I_mCD_{30}), Nitrogen @ 30 kg/ha (N_{30}), Cowdung @ 30 t/ha (CD_{30}), Mixed inoculant + Nitrogen @ 30 kg/ha + Cowdung ($I_mN_{30}CD_{30}$) and uninoculated Old Bramaputra Floodpalin soil as control (I_o). The experiment was laid out in split-plot design using bioinoculant and other fertilizers in sub plots and soils in main plots with three replications. Healthy, vigorous, pulmy and well mature seeds of Akashmoni were soaked in hot water for 3 minutes then was kept in rest for over night for breaking the dormancy. For raising the seedling, one seed was placed in each poly bag at 3 to 4 cm depth of soil which was 9 cm in height and 5 cm diameter, received 120 gm

soil and cowdung at the ratio was 3:1. Poly bags were watered as increasing the soil moisture for better seed germination and were covered with a polythene sheet up to the germination. The soil was collected from the arable land of Agroforestry Farm, Bangladesh Agricultural University, Mymensingh, from a depth of 0-15 cm and then dried in the sun and removed of plant roots, pebbles etc. and mixed up thoroughly. An amount of 8 kg soil was taken in a series of earthen pots having a diameter of 25 cm and height was 25 cm. After 20 days of seedling emergence saplings were transplanted into the middle in each pot with soil ball surrounded the root systems and then irrigated properly. The rhizobial inoculants used in this study were prepared in the Biofertilizer Laboratory at BINA, Mymensingh following the method of Vincent (1970). Mixed culture inoculant was inoculated into respective pots and then inoculated soil was incorporated with respective pot soil before transplanting of 20 day old sapling in the pots. At the time of transplanting the sapling into the pot finally, 55 kg potassium/ha (22 mg/pot) and 15 kg phosphorus/ha (6 mg/pot) were applied as basal dose. Nitrogen @ 30 kg/ha (105 mg/pot) was applied at two installment, first dose was applied at transplanting of sapling into respective pot and second dose was 30 days after transplanting of Akashmoni sapling. Cowdung was incorporated with respective pots @ 30 t/ha (115 g/pot). Intercultural operations were done when necessary during the study period. After 60 days of inoculation the Akshmoni sapling were harvested at a time through separating of plants with soils from pot and breaking the soil aggregated by hand maintaining intact root system and nodules. Root systems containing nodules were then washed through dipping into a plastic bucket containing fresh tap water and made ready for observation and recording of data of different parameters. For recording of dry weights nodules, shoot, leaf, and roots were dried in the sun for 2 days then over dried for 3 days at 65°C. The collected data were analyzed statistically by F-test to examine whether treatment effects were significant or not and correlation and regression between different characters of Akashmoni were also evaluated (Gomez and Gomez, 1984).

Results and Discussion

Nodule number: The result on the effect of bioinoculant, urea and cowdung on total nodule number and nodule dry weight of Akashmoni sapling were presented in Table 1. Data showed that the effect of inoculant on nodule number was highly significant over control, urea and cowdung application and the nodule number ranged from 16.50 to 61.83 per plant. Treatment $I_mN_{30}CD_{30}$ produced the highest nodule number (61.83/plant) where urea treatment (N_{30}) produced the lowest nodule (16.50/plant). Second highest nodule numbers (58.16/plant) were produced by the treatment $ImCD_{30}$ which is identical with the treatments I_m and I_mN_{30}. Lowest nodule number was found in N_{30} (16.50/sapling) treatment which was statistically identical with the control (I_0) (20.17/sapling) and CD_{30} (21.66/plant). Interaction effect of fertilizer and soil, $I_mN_{30}CD_{30}$ produced the highest nodule number (22.00/sapling) which was statistically identical with the treatment I_m (18.66/plant), I_mN_{30} (18.33/plant), I_mCD_{30} (17.33/sapling) and (I_0) (16.00/sapling). Subba Rao (1995) stated similar results that *Rhizobium* inoculaton in tree legumes increased nodule mass.

Nodule Dry weight: Data showed that treatment $I_mN_{30}CD_{30}$ produced the highest nodule dry weight (53.00 mg/plant) where N_{30} produced the lowest nodule dry weight (11.50 mg/pant). Treatment N_{30} (11.50 mg/ plant), CD_{30} (14.50 mg/plant) and control (12.50 mg/plant) are statistically similar. Second highest nodule dry weight was produced by the treatment I_mCD_{30} (47.50 mg/plant) which was statistically identical with the treatment I_m (44.00 mg/plant) and 1_mN_{30} (38.72 mg/plant). Table.1 also showed significantly higher nodule dry weight due to inoculation over control and the interaction effect of fertilizers and soil on nodule dry weight was insignificant. Jain *et al.* (1988) reported that nodulation increased with *Rhizobium* inoculants and dry matter also increased.

Table 1. Effect of fertilizers, soil and their interaction on nodule number and nodule dry weight of akashmoni

Treatments	Total nodule (No./plant)	Nodule dry weight (mg/palnt)
Bioinoculant/Fertilizers		
I_m	53.00ab	44.00b
I_mN_{30}	47.83b	38.72b
I_mCD_{30}	58.16ab	47.50b
N_{30}	16.50c	11.50c
CD_{30}	21.66c	14.50c
I_m $N_{30}CD_{30}$	61.83a	53.00a
I_0	20.17c	12.50c
Level of significance	**	**
Soil	15.48b	0.57b
Level of significance	**	**
Soil ×Fertilizers interaction		
Soil× I_m	18.66cde	36.00
Soil× I_mN_{30}	18.33cde	29.44
Soil× I_mCD_{30}	17.66cde	42.00
Soil× N_{30}	5.66e	6.00
Soil × CD_{30}	10.00de	5.00
Soil× $I_mN_{30}CD_{30}$	22.00cde	48.00
Soil × I_0	16.00cde	4.00
Level of significance	**	NS
CV %	18.79	25.17

In a column, figures having similar letters do not differ significantly as per DMRT, ** Significant at 1% level, NS (Non significant)

Shoot height: The effect of treatments and soil individually increased shoot height of Akashmoni which is highly significant. Result recorded in Table 2 revealed that due to inoculation shoot height was increased in Akashmoni sapling. Data (Table 2 and Plate 1) indicated that shoot height ranged from 26.83cm (I_0) to 39.33cm ($I_mN_{30}CD_{30}$). Results indicated that the treatment $I_mN_{30}CD_{30}$ produced significantly higher shoot height (39.33 cm/plant) over control (I_0) and urea applied treatment N_{30} (32.00 cm/plant). Treatment CD_{30} (35.17cm/plant), I_mCD_{30} (34.92cm/plant) I_mN_{30} (33.92 cm /plant) and I_m (33.92 cm/plant) was found statistically identical to treatment $I_mN_{30}CD_{30}$ (39.33cm/plant). Treatments I_m (33.92 cm/plant), I_mN_{30} (33.92 cm/plant), N_{30} (32.00), I_mCD_{30} (34.92 cm/plant) and CD_{30} (35.17 cm/plant) are statistically similar and superior to control (26.83cm/Plant) and also there is no significant difference between the treatment N_{30} (32.00cm/Plant) and control (I_0). The interaction effect of bioinoculant and soil on height of Akashmoni was insignificant. However, $I_mN_{30}CD_{30}$ produced the highest shoot height (38.33 cm/plant) followed by CD_{30} (35.50 cm/plant), I_mCD_{30} (34.16cm/plant) and N_{30} (33.00 cm/plant).

Shoot fresh weight: The effect of bioinoculant, urea and cowdung over shoot fresh weight of Akashmoni sapling has been presented in table 2. The shoot fresh weight ranged from 6.70 gm/plant (I_0) to 10.45 gm/plant (I_mN_{30} CD_{30}). Result indicate that bioinoculant treatment $I_mN_{30}CD_{30}$, produced highest shoot fresh weight of Akashmoni among treatments but identical with all other treatments except control (I_0). Result also indicate that all the treatments viz. I_m (8.88 gm/plant), I_mN_{30} (9.30gm/plant), I_mCD_{30} (8.69 gm/plant), N_{30} (8.59gm/plant), CD_{30} (8.77gm/plant), and $I_mN_{30}CD_{30}$ (10.45 gm/plant) were superior to control (I_0). Interaction effect of fertilizers and soil, $I_mN_{30}CD_{30}$ produced the highest shoot fresh weight (9.90gm/plant) followed by I_mN_{30} (8.99gm/plant) and I_mCD_{30} (8.86 gm/plant). Results (Table 2) showed that the interaction effect of bioinoculant and soil on shoot fresh weight of Akashmoni sapling was statistically insignificant.

Shoot dry weight: There was a significant difference among the treatments on shoot dry weight of Akashmoni (Table 2) that ranged from 2.99gm/plant (control) to 4.68 gm/plant ($I_mN_{30}CD_{30}$). Data showed that all the bioinoculant treatment produced higher shoot dry weight over control (I_0) and urea applied treatment (N_{30}). Treatment $I_mN_{30}CD_{30}$ produced highest amount (4.68 gm/plant) of shoot dry weight of Akashmoni sapling. Treatment I_m (3.98 gm/plant), I_mN_{30} (4.13gm/palnt), I_mCD_{30} (3.96gm/plant) and CD_{30} (4.01 gm/plant) produced higher amount of shoot dry weight over control (2.99gm/plant) and identical with the treatment $I_mN_{30}CD_{30}$ (4.68gm/plant). Urea treatment N_{30} (3.39gm/plant) was identical with I_m, I_mN_{30}, I_mCD_{30} and CD_{30} but there was no statistical difference between N_{30} and control (I_0). The interaction effect of soil and bioinoculant treatment was statistically insignificant and bioinoculant treatment $I_mN_{30}CD_{30}$ produced highest shoot dry weight (3.87 gm/plant) flowed by CD_{30}(3.75 gm/plant) and I_mN_{30} (3.73 gm/plant). Subba Rao (1995) stated similar results that *Rhizobium* inoculaton in tree legumes increased shoot dry matter.

Leaf number: There were significant differences among the treatments in respect of leaf number of Akashmoni sapling showed in Table 3. Result indicated that the effect of all the bioinoculant treatments were superior over control. The number of leaf per sapling ranged from 23.00 in control to 44.17 in bioinoculant treatment.

Table 2. Effect of fertilizers, soil and their interaction on shoot height, shoot fresh weight and shoot dry weight of akashmoni

Treatments	Shoot height (cm. /plant)	Shoot fresh weight (gm/plant)	Shoot dry weight (gm/plant)
Bioinoculant/Fertilizers			
I_m	33.92ab	8.88a	3.98ab
I_mN_{30}	33.92ab	9.30a	4.13ab
I_mCD_{30}	34.92ab	8.69a	3.96ab
N_{30}	32.00bc	8.59a	3.39bc
CD_{30}	35.17ab	8.77a	4.01ab
$I_mN_{30}CD_{30}$	39.33a	10.45a	4.68a
I_0	26.83c	6.70b	2.99c
Level of significance	**	**	**
Soil	32.45b	8.22b	3.46b
Level of significance	*	*	*
Soil × Fertilizers interaction			
Soil× I_m	31.33	7.96	3.63
Soil× I_mN_{30}	31.16	8.99	3.73
Soil × I_mCD_{30}	34.16	8.68	3.66
Soil× N_{30}	33.00	8.32	3.00
Soil × CD_{30}	35.50	7.70	3.75
Soil× I_m N_{30} CD_{30}	38.33	9.90	3.87
Soil × I_0	23.66	6.01	2.53
Level of significance	NS	NS	NS
CV %	10.5	12.59	11.03

In a column, figures having similar letters do not differ significantly as per DMRT, * (Significant at 5% level), ** Significant at 1% level and NS (Non-significant)

Bioinoculant treatment $I_mN_{30}CD_{30}$ produced the highest leaf number (44.17/plant).Treatment CD_{30} (37.50/plant) produced second highest leaf number which was statistically identical with the treatment N_{30} (36.00/plant) and I_mCD_{30} (36.83/plant). Treatment I_mN_{30} (33.17/plant) produced statistically higher leaf number over I_m (29.33/plant) and control (23.00plant). I_mN_{30}, I_mCD_{30} and urea treatment N_{30} showed statistically identical. There was no significant interaction effect of soil and bioinoculant treatment on leaf number. Treatment $I_mN_{30}CD_{30}$ produced higher leaf (46.00/plant) followed by CD_{30} (39.00/plant) and N_{30} (38.00/plant).

Leaf fresh weight: The effect of bioinoculant, urea and cowdung on in the leaf fresh weight were significant. Leaf fresh weight ranged from 5.29gm/plant (control) to 8.89gm/plant ($I_mN_{30}CD_{30}$). Treatment $I_mN_{30}CD_{30}$ resulted significantly higher leaf fresh weight over CD_{30} (7.81gm/plant), I_m N_{30} (7.59gmplant) and I_mCD_{30} (7.27gm/palnt). Treatment CD_{30} (7.81gmplant), I_mCD_{30} (7.27gm/plant), I_mN_{30} (7.59gm/plant) showed statistically identical with I_m (5.99gm/plant). Treatment I_mCD_{30} (7.27gm/palnt) was statistically identical with N_{30} (6.22 gm/plant) and I_m (5.99 gm/plant). There was no significant interaction observed in soil and fertilizers treatment on leaf fresh weight. Higher leaf fresh weight (8.91 gm/plant) was observed by the treatment I_mN_{30} CD_{30} followed by CD_{30} (7.036 gm/plant).

Leaf Dry weight: The effect of bioinoculant, urea and cowdung on leaf dry weight of Akashmoni sapling found that there was a significant effect obtained in bioinoculant treatment over control. Treatment $I_mN_{30}CD_{30}$ (3.67 gm/plant) produced the highest leaf dry weight and lowest was recorded in control (2.21gm/plant). All other bioinoculant treatment viz. I_m (3.31 gm/plant), I_mN_{30} (3.54 gm/plant), I_mCD_{30} (3.29 gm/plant), N_{30} (3.02 gm/plant) and cowdung CD_{30} (3.16gm/plant) significantly produced higher leaf dry weight over control (I_0) (2.21gm/plant). All bioinoculant treatments were statistically identical. There was insignificant interaction observed in soil and bioinoculant treatment on leaf dry weight. Treatment I_mN_{30} was produced higher leaf dry weight (3.37 gm/plant) followed by $I_mN_{30}CD_{30}$ (3.30 gm/plant) and CD_{30} (2.90 gm/plant).

Table 3. Effect of fertilizers, soil and their interaction on leaf number, leaf fresh weight and leaf dry weight of akashmoni

Treatments	Leaf Number (No./plant)	Leaf fresh weight (gm/plant)	Leaf dry weight (gm/plant)
Bioinoculant /Fertilizers			
I_m	29.33d	5.99bc	3.31a
I_mN_{30}	33.17c	7.59ab	3.54a
I_mCD_{30}	36.83bc	7.27abc	3.29a
N_{30}	36.00bc	6.22bc	3.02a
CD_{30}	37.50b	7.81ab	3.16a
$I_mN_{30}CD_{30}$	44.17a	8.89a	3.67a
I_0	23.00e	5.29c	2.21b
Level of significance	**	**	**
Soil	35.38a	6.35b	2.91b
Level of significance	**	**	**
Soil × Fertilizers interaction			
Soil× I_m	31.00	4.73	3.05
Soil× I_mN_{30}	35.33	6.36	3.37
Soil × I_mCD_{30}	37.33	6.34	3.01
Soil× N_{30}	38.00	6.29	2.70
Soil × CD_{30}	39.00	7.036	2.90
Soil× $I_mN_{30}CD_{30}$	46.00	8.91	3.30
Soil × I_0	21.00	4.79	2.05
Level of significance	NS	NS	NS
CV %	8.74	17.66	14.55

In a column, figures having similar letters do not differ significantly as per DMRT, ** Significant at 1% level, NS (Non-significant)

Root length: The effect of bioinoculant on root length of Akashmoni sapling was insignificant presented in Table 4. However, I_mCD_{30} produced the highest root length (60.83cm/plant) followed by $I_mN_{30}CD_{30}$ (59.30cm/plant) and I_mN_{30} (56.67cm/plant). Lowest root length was observed in control (49.836 cm/plant). In the interaction of soil and bioinoculant no significant effect was observed on root length of Akashmoni sapling. Highest root length was found in I_mCD_{30} (58.00cm/plant), treatment $I_mN_{30}CD_{30}$ (56.00cm/plant) and CD_{30}(55.00cm/plant) produced more root length where control produced lowest (45.83cm/plant).

Root fresh weight: The effect of bionoculant and other treatments on root fresh weight of Akashmoni sapling was significant. Root fiesh weight ranged from 1.15gm/plant (N_{30}) to 2.12 gm/plant (I_mN_{30} CD_{30}). Data showed (Table 4) that among all the bioinoculant treatment $I_mN_{30}CD_{30}$ produced significantly higher root fresh weight (2.12gm/plant) which was statistically identical to I_mCD_{30}(1.69gm/plant). Treatment I_mCD_{30} (1.69gm/plant) produced higher root fresh weight over N_{30} (1.15gm/plant) and were identical with $I_mN_{30}CD_{30}$, CD_{30} (1.62gm/plant), I_mN_{30} (1.42gm/plant), I_m (1.37gm/plant) and control (I_0). Treatment N_{30} (1.15gm/plant) produced lowest root fresh weight and was statistically identical with CD_{30}, I_mN_{30}, I_m and control treatments. Table 4 indicated that soil and bioinoculant interaction on root fresh weight was significant. Treatment $I_mN_{30}CD_{30}$ produced the highest root fresh weight (1.82gm/plant) over all other treatment which was significant and was statistically identical with

CD_{30} (1.42gm/plant) and I_mCD_{30} (1.24gm/plant). Treatment CD_{30} produced (1.42gmplant) but statistically identical with I_mCD_{30} (1.24gm/plant), I_m (1.16gm/plant) and I_mN_{30} (1.13gm/plant). Treatment N_{30} (0.43gm/plant) and control (0.87gm/plant) were statistically identical.

Root dry weight: A significant increase in root dry weight of Akashmoni sapling was observed due to different treatments (Table 4). Treatment $I_mN_{30}CD_{30}$ showed highest root dry weight (0.90 gm/plant), where the lowest were found in N_{30} (0.45gm/plant). More or less similar root dry weight was found in the treatment CD_{30} (0.67 gm/plant), I_mCD_{30} (0.68 gm/plant), I_mN_{30} (0.56gm/plant), I_m (0.53 gm/plant) and control (0.60 gm/plant) which were statistically identical. Control gave higher root dry weight than N_{30}. Treatment N_{30}, I_mN_{30} and I_m were statistically similar. The interaction effect of soil and bioinoculant on root dry weight was significant. Higher root dry weight was produced in treatment I_mN_{30} CD_{30} (0.85 gm/plant). Second height root dry weight was recorded by CD_{30} (0.73 gm/plant) at the same soil and was statistically identical with $I_mN_{30}CD_{30}$.

Table 4. Effect of fertilizers, soil and their interaction on root length, leaf root fresh weight and root dry weight of akashmoni

Treatments	Root length (cm/plant)	Root fresh weight (gm/plant)	Root dry weight (gm/plant)
Bioinoculant /Fertilizers			
I_m	54.33	1.37bc	0.53bc
I_mN_{30}	56.67	1.42bc	0.56bc
I_mCD_{30}	60.83	1.69ab	0.68b
N_{30}	53.58	1.15c	0.45c
CD_{30}	55.00	1.62bc	0.67b
$I_mN_{30}CD_{30}$	59.30	2.12a	0.90a
I_0	49.836	1.24bc	0.60b
Level of significance	NS	**	**
Soil	51.51b	1.18b	0.57b
Level of significance	**	**	**
Soil × Fertilizers interaction			
Soil× I_m	46.66	1.16de	0.58cde
Soil× I_mN_{30}	50.00	1.13de	0.52de
Soil × I_mCD_{30}	58.66	1.24cd	0.62cde
Soil× N_{30}	47.83	0.43f	0.22f
Soil × CD_{30}	55.00	1.42cd	0.73bcd
Soil× $I_mN_{30}CD_{30}$	56.00	1.82bc	0.85ab
Soil × I_0	45.83	0.87cf	0.50de
Level of significance	NS	*	**
CV %	14.18	17.86	13.88

In a column, figures having similar letters do not differ significantly as per DMRT, * (Significant at 5% level), ** Significant at 1% level and NS (Non-significant)

Correlation and regression studies: Statistical relationship between nodule number and nodule dry weight, nodule and shoot height, nodule number and shoot dry weight, nodule number and root dry weight, nodule dry weight and shoot height, nodule dry weight and shoot dry weight, nodule dry weight and leaf dry weight, shoot dry weight and leaf dry weight, shoot dry weight and root dry weight have been presented in Table 5 and found that all relationships are positively correlated.

Table 5. Correlation matrix of different selected characters of Akashmoni

Factors of correlation	Correlation co-efficient (r)
Nodule number vs nodule dry weight	0.778**
Nodule number vs shoot height	0.534**
Nodule number vs shoot dry weight	0.732**
Nodule number vs root dry weight	0.404*
Nodule dry weight vs shoot height	0.682**
Nodule dry weight vs shoot dry weight	0.699**
Nodule dry weight vs leaf dry weight	0.650**
Shoot dry weight vs leaf dry weight	0.835**
Shoot dry weight vs root dry weight	0.525**

** (Significant at 1%) and * (Significant at 5%)

In this experiment among the treatments $I_mN_{30}CD_{30}$ was found as the best but in case of scarcity and higher cost of urea (N_{30}), farmers can apply I_mCD_{30} for better growth of Akashmoni for reducing cost of production, sustainable soil fertility and environmentally friendly cultivation in nursery for sapling production. Further trail is necessary for confirmation of the present findings.

Plate 1. Photograph showing the effect of bionioculant, urea and cowdung on nodulation, growth of Akashmoni as affected by Old Bramaputra Floodpalin soil

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