Physical Aspects of Soil Management

Determination of crop coefficient values of Sweet pepper and estimation of leaching loss of nutrients through Lysimeteric study

A.T.M.A.I. Mondol, M.J. Alam and H.M. Naser

A study on sweet pepper (cv. BARI Misti morich-1) was conducted in the drainage Lysimeter located in the Central Research Farm, BARI, Gazipur during rabi 2020-2021 and 2021-2022. The objective of the study was to find out the location specific crop coefficient (Kc) values for sweet pepper and to estimate leaching loss of nutrients. Four regimes of irrigation water were applied on the basis of depletion over field capacity (FC) at predetermined intervals such as T_1: Irrigation up to FC at 5 days interval, T_2: Irrigation up to FC at 10 days interval, T_3: Irrigation up to FC at 15 days interval and T_4: Irrigation up to FC at 20 days interval. As such, 11, 8, 6 and 4 irrigations were needed for T_1, T_2, T_3 and T_4, respectively. The experiment was conducted in completely randomized design with 3 replications. The highest sweet pepper yield (26.1 t ha^{-1}) was obtained from T_2, which was significantly higher to other treatments. Therefore, Kc values were calculated from the best performed treatment, T_2. The estimated average Kc values for sweet pepper during rabi season found to be 0.43, 0.82, 94.0 and 0.86 for initial, crop development, mid-season and late season stages, respectively. Thus the values determined from this study may be recommended for Bangladesh and similar climate elsewhere to estimate crop water requirement for sweet pepper. Significant amount of plant nutrients (K, Ca, Mg, S, Zn and B) was lost through leaching. The loss of Ca, Mg and S found to be a great concern. This should be taken into account for ensuring crop nutrition and minimizing ground water pollution.

Synchronization of different aged compost to crop demand, nutrient release and their contribution to the production of Red amaranth

A.T.M.A.I. Mondol, M.J. Alam and H.M. Naser

This study was conducted at the research field of Soil Science Division, Bangladesh Agricultural Research Institute (BARI), Gazipur under AEZ-28 during rabi season of 2021-2022 to understand the release of nutrients for crops and their contribution to growth and yield. Red amaranth cv. BARI Lalshak-1 was used for this experiment. Four different organic amendments of different ages were studied in comparison with only chemical fertilizer application. The amendment treatments were T_1: 30 days aged compost,T_2: 45 days aged compost,T_3: 60 days aged compost, T_4: 75 days aged compost and T_5: only chemical fertilizers. The experiment is laid out in a Randomized Complete Block Design (RCBD), where each treatment was replicated thrice. Data on growth and yield attributes of red amaranthus were collected during the crop growing season and after harvesting. Necessary sample were also collected periodically to determine the microbial-respiration of soil during the experimental period. Yield and its component of red amaranthus were significantly affected by the different aged compost. The organic amended performed in the sequence: 75 DOC>60 DOC>45 DOC>30 DOC. The increases of yield in 75 DOC, 60 DOC, 45 DOC and 30 DOC were 98.6, 79.7, 60.8 and 54.0%, respectively higher than yield obtained with only chemical fertilizer. A significant increase in yield, individual plant weight, plant height and number of leaves $plant^{-1}$of red amaranth was

obtained with organic amended treatments relative to only chemical fertilizer application. The hetero-tropic respiration (CO_2 emission) was found higher in soils under75 DOC at 21 days after seed sowing which might be due to synchronization with crop nutrient demand.However no discreet decision can be drawn unless the experiment continues for more years.

Effect of conservation tillage and phosphorus on the productivity of Gardenpea-Maize-T.aman rice cropping pattern and soil physico-chemical properties

M.J. Alam, A.T.M.A.I. Mondol and H.M. Naser

A field experiments on Garden pea- Maize-T.aman rice cropping pattern were conducted in Grey Terrace soil of Joydebpur under AEZ-28 during rabi 2018-2019, 2019-2020 and 2020-2021to observe the effect of tillage practices and phosphorus on soil properties and to increase the productivity of cropping system. There were 2 types of tillage such as Strip tillage (ST) and conventional tillage (CT). In addition, 3 forms application of phosphorus such as granular dose (basal) (P_1), powder doses (basal) (P_2) and granular doses (split) (P_3) in a split plot RCB design with 6 treatments and 3 replications. Strip tillage (ST) gave more grain yield than conventional tillage (CT) for maize ($p\leq0.05$) and vice-versa for T. aman rice ($p\geq0.05$) due to residual nutrient uptake factor for subsequent crop. Powder dose (basal) significantly performed the best than other phosphorus doses for both maize and T. aman ($p\geq0.05$). Strip tillage with phosphorus combinations comparatively gave more moisture and field capacity than conventional tillage with phosphorus combinations and vice-versa for bulk density. OM, N, P, K, S and Zn increased but pH remain more or less same and B content decreased compare to initial soil. The 10^{th} crop garden pea damaged at flowering condition due to heavy rain for cyclone Jaoyad. The 11^{th} crop maize was harvested during report writing.

Effect of crop establishment practices and IPNS based nutrient management on Cabbage-Indian spinach-T.aman cropping system and soil physico-chemical properties

M.J. Alam, A.T.M.A.I. Mondol and H.M. Naser

A field experiments on Cabbage-Indian spinach-T.aman rice cropping pattern were conducted in Grey Terrace soil of Joydebpur under AEZ-28 during rabi 2019-2020, 2020-2021 and 2021-2022 to investigate the performance of crops in vegetable based triple crops cropping system under the crop establishment and organic fertilizer application practices and to study the soil physic-chemical properties under crop establishment and organic dominant IPNS in the cropping system. There were 2 types of tillage such as Strip tillage (ST) and conventional tillage (CT). In addition, 3 nutrient management practices such as 100% organic fertilizer, IPNS and 100% chemical fertilizers in a split plot design with 6 treatments and 3 replications. Strip tillage gave better yield for cabbage and for T.aman but vice-versa for Indian spinach. IPNS package gave the maximum yield for Indian spinach, and cabbage where 100% Organic fertilizer gave the maximum yield for T.aman under Cabbage- Indian spinach-T. aman cropping pattern. CO_2 emission was more in conventional tillage than strip tillage during cabbage growing period. 100% organic fertilizer treatment emitted more CO_2 than IPNS and 100% chemical fertilizer and IPNS emitted less CO_2. Strip tillage gave more field capacity, soil moisture and less bulk density than conventional tillage. Organic based nutrient package gave more moisture, field capacity and

less bulk density than chemical fertilizer. Organic based nutrient package increased OM, N and Zn than chemical fertilizer treatment. In case of Organic based treatment pH, P, K and S increased but more or less remain same for chemical based fertilizer compare to initial soil. B decreased compare to initial soil. The 8th crop Indian spinach is on field and harvesting going on during report writing.

Requirement of nitrogen for Mustard-Okra- T.aman cropping system based on conservation agricultural practices

M.J. Alam, A.T.M.A.I. Mondol and H.M. Naser

A field experiments on Mustard-Okra-T.aman rice cropping pattern was conducted in Grey Terrace soil of Joydebpur under AEZ-28 during rabi2021-2022 to investigate the rate of nitrogen fertilizer for the intensive mustard-okra- T. aman cropping system under CA practices, to evaluate the effet of nitrogen and tillage on soil physico-chemical properties and to assess the system productivity. There were 3 types of tillage such as strip tillage (ST), zero tillage (ZT) and conventional tillage (CT). In addition, nitrogen management practices such as 100% nitrogen (N_1), 125% nitrogen (N_2), 75% nitrogen (N_3) and 50% nitrogen (N_4) in a split plot design with 12 treatments and 3 replications. Mustard was the first crop and 125% nitrogrn doses gave the maximum result than other doses. The second crop okra harvesting going on during report writing.

Effect of minimum tillage and crop residue retention on soil physico-chemical properties and crop yields under a rice-based cropping system

N. Salahin, N.U. Mahmud, M.J. Alam and K.U. Ahammad

An experiment was conducted at Regional Agricultural Research Station (RARS), Jashore during 2016-2017 to 2021-2022 cropping years to observe the effects of tillage and residue retention on soil physico-chemical properties and crop yields along with to assess the system productivity in rice-based cropping system. Two tillage practices such as, T_1: conventional tillage (CT) and T_2: minimum tillage (MT) were assigned in main plot and two levels of residue retention such as R^+: 30 cm crop residue retention/incorporation of wheat and rice and full straw retention of mungbean and removal of crop residue. Tillage practices had significant effect on the grain yield of T. Aman rice in the 2021 cropping year and higher grain yield was obtained from conventional puddling system than that of minimum tillage system. The MT and CT gave statistically similar mungbean and wheat yield as well as rice equivalent yield. After 15th crop harvest, conservation agriculture showed soil properties improvement over conventional agriculture system.

Requirement of k fertilizer under conservation agriculture practices in the intensive Wheat Mungbean-T. aman cropping system

N. Salahin, N.U. Mahmud, M.J. Alam and K. U. Ahammad

An experiment was conducted at Regional Agricultural Research Station (RARS), Jashore during 2019-2020 and 2020-2021 to determine the optimum rate of potassium fertilizer under conservation agriculture (CA) practice and to evaluate the effects of K fertilizer on soil properties and cropping system productivity. Two crop establishment methods, such as, T_1: conventional method (excessive tillage + residue removal) and T_2: conservation agriculture (minimum tillage + residue retention) were assigned in main plots whereas four K fertilizer rates were applied as K_1: 75% of recommended rate of K (RDK), K_2: 100% of RDK, K_3: 125% of RDK and K_4: 150% of RDK were allotted in sub-plots. Potassium fertilizer rates showed significant performance in the yield and yield attributes of wheat regardless of crop establishment methods. The longest spike, highest number of spikelets and filled grains spike^{-1} of wheat was obtained from plots receiving 150% and 125% of RDK. Consequently, significantly the highest grain yield (4.47 t ha^{-1}) of wheat obtained from the plots receiving 150% and 125% of RDK) and differed from 100 and 75% of RDK. In case of T. Aman, crop establishment methods showed significant variations on the panicle length and number of filled grains spike^{-1} whereas effective tillers hill^{-1}, panicle length, number of filled grains spike^{-1} and 1000-grain wt. of T. aman increased with increasing K rates. As a result, higher grain yield (4.79 t ha^{-1}) was obtained from the conventionally crop establishment method compared to conservation agriculture practice (4.42 t ha^{-1}). Highest grain yield (5.11 t ha^{-1}) of T. aman was obtained from plots receiving 150% of RDK which were different from other K rates. There was no variation in mungbean performance due to crop establishment methods and K fertilizer rate. In addition higher K doses (150% and 125% of RDK) gave the higher REY than those of lower RDK. Soil organic matter and available K content significantly improved due to CA practice.

Chemical Aspects of Soil Management

Nutrient management for sustaining soil fertility and yield of Wheat-Mungbean-T.aman cropping pattern

M.M. Masud, N.U. Mahmud, N. Salahin, R. Sen and H.M. Naser

A long term field experiment on Wheat-Mungbean-T.aman cropping pattern has been carried out in High Ganges Floodplain Soils (AEZ-11) of RARS, Jashore from 2000-2021. The objectives were to find out sustainable fertilizer recommendations, monitor soil health, estimate uptake of different nutrient for the cropping pattern and to make a balance sheet for each of the nutrient. There were six treatments viz. 125% recommended dose (RD), 100% RD, 75% RD, 50% RD, farmers' practice and native nutrient. The design was RCB with three replications. Results showed consistently highest yield from each of the crops of the pattern obtained with 125% RD treatment and which were statistically similar to 100% RD treatment. Highest total rice (system) yield of 13.21 t ha-1yr-1 was obtained from T1 treatment (125% RD). Lowest total rice (system) yield of 7.00 t ha-1yr-1 was obtained from control i.e. native fertility treatment (T6). Highest gross margin of 123309 tk. ha^{-1} yr^{-1} was also obtained from T1 treatment (125% RD). The highest benefit cost ratio of 1.88 was found in T1 (125% RD) treatment.

Nutrient management for sustaining soil fertility and yield of Mustard-Mungbean-T.aman cropping pattern

M.M. Masud, N.U. Mahmud, N. Salahin, R. Sen and H.M. Naser

A long term field trial on Mustard-Mungbean-T.aman cropping pattern has been conducted from 2000-2021 in High Ganges Floodplain Soils (AEZ-11) of Jashore. The objectives were to find out sustainable fertilizer doses for the pattern, monitor soil health, estimate uptake of different nutrients and make a balance sheet for each of the nutrient. There were three levels each of N (80, 120 and 160 kg ha-1), P (18, 36 and 54 kg ha-1) and K (35, 70 and 105 kg ha-1) in the treatment combinations. The design was RCB with three replications. The combined effect of 120-54-70-40-3-1 kg ha-1 of NPKSZnB (T5) produced the highest seed yield (1.53 t ha-1) of mustard. The residual effect of 120-54-70-40-3-1 kg ha-1 of NPKSZnB (T5) gave the highest yield of both grain and straw yield of mungbean and T.aman rice. Highest total rice (system) yield of 14.85 t ha-1yr-1 was obtained from T5 treatment. The lowest total rice (system) yield of 8.58 t ha-1yr-1 was obtained from control i.e. native fertility treatment (T8). The highest gross margin of 1,36,37 tk ha^{-1} yr^{-1} and BCR of 1.85 obtained from T5 treatment. It was observed that a total amount of 1346, 285, 1242, 211 and 11 kg ha-1 of NPKS and Zn were removed from the soil by sixteen cropping cycles while 1300, 540, 700, 250, and 15 kg ha-1 of NPKS and Zn were added in the soil as nutrients. N and K removal were found to be higher than the amount added. About 129, 71 and 7 kg ha-1 of P, S and Zn were added in soil system when about 90 t ha-1 of green biomass of mungbean from sixteen cropping cycles were ploughed down after grain harvest.

Long-term integrated nutrient management for sustaining soil fertility and yield of Maize-Mungbean-T. aman cropping pattern

M.R. Khatun, M.M. Masud, M.M. Sultana, I.S.M. Farhad, A. Barman. and H.M. Naser

A long-term field experiment on Maize-Mungbean-T.aman cropping pattern was conducted in the Grey Terrace Soil (AEZ-28) of Gazipur during the year of 2008-2022 with the objectives of finding out suitable fertilizer combination for sustainable yield of the pattern, monitoring soil health as affected by chemical fertilizers and organic manures and to make a balanced sheet of each nutrient. There were six treatments viz. T1: Native fertility, T2: 75% of Soil Test Based (STB) chemical fertilizer+ 5 t ha-1 CD, T3: 100% of STB chemical fertilizer, T4: 100% of STB chemical fertilizer + 5 t ha-1 CD, T5: 100% of STB chemical fertilizer + 3 t ha-1 PM and T6: 75% of STB chemical fertilizer. The experiment was laid out in RCB design with four replications. Data revealed that the T5 treatment produced the highest yield of maize grain consistently in fourteen cropping cycle. The legume component (mungbean) produced over 1 t ha-1 grain and added over 13 t ha-1 green biomass. The third crop (T.aman rice) also produced the highest grain yield in the T5 treatment. The yields of maize and rice were statistically similar to all other fertilizer treatments. The native fertility treatment produced the lowest yield. This trend of influence was consistent for almost all the yield contributing characters of maize and T. aman rice. N, K and S balances were found negative whereas P balance was found positive except T1 treatment (native fertility).

Effect of crop residue and their biochars on Maize yield

M.M. Masud, M.M. Sultana, A. Barman, M.R. Khatun, I.S.M. Farhad and H.M. Naser

A study was conducted on the effects of crop straw and its derived biochars on maize (BARI Khoi bhutta) yield at Central research field, BARI, Gazipur under Grey Terrace Soil (AEZ 28) from 2018-2021. Three crop straws (i.e. groundnut straw, chickpea straw and mustard straw) and their derived biochars were used where cowdung used as comparison. The experiment consisted of eight treatments laid out in randomized complete block design with three replications. The changes of soil properties like pH, organic matter content and soil health effect on yield and yield components of maize were investigated. Results indicated biochar, especially those were high in pH, enhanced soil pH (>0.2 units, $p < 0.05$), whereas reduction and or unaffected soil pH was observed among treatments with crop straws. The organic matter content increased with the application of crop straws and biochars as well as cowdung. After three years study, result showed that biochar treated soil increased and last in soil ranges from (0.21 to 0.27 unit) but crop straw increased only 0.04 units. Initially, carbon stock increased average 28% by using crop straw and crop straw derivate biochar increased average 75% from initial soil organic carbon where chickpea straw biochar increased greater (77%). The carbon content decreased almost full from CD and crop straw treated soil but biochar amended plot decreased a little form first year to third year. Greater nutrient uptake by maize were observed with the treatment receiving biochar compared to crop straw as well as cowdung and no amendment plot, respectively. The lowest uptake of nutrient element was recorded in treatment receiving amendment plot (100% RDCF). The incorporation of biochar not only neutralizes soil acidity, but can also improve soil fertility and carbon stock into the soil. Three years average results on the yield parameters of the BARI

Khoi bhutta showed that crop straw increased the grain yield from 4.55 t ha-1 to 4.67 t ha-1 where crop straw biochar increased 5.12 t ha-1 to 5.60 t ha-1, where 4.53 t ha-1yield obtained from RDCF with cowdung 5 t ha-1, that is 20% higher yield produced from RDCF treatment. Crop straw biochar enhanced the yield up to 45% from RDCF and 25% from crop straw but statistically higher yield in chickpea straw biochar (CSB) treated plot. The overall result indicated that RDCF with 10 t ha-1 CSB out of three crop straw biochars showed more effective for Khoi butta yield and improve soil fertility.

Nutrient management for a rooftop garden

A. Barman, I.S.M. Farhad, M. Sultana, R. Khatun, M.M. Masud, R. Sen and H.M. Naser

The study has been conducted in Gazipur (rooftop of Soil Science Division) during the year of 2020-2021 and 2021-2022. Two types of research work have been conducted in this study. One is organic and inorganic fertilizer combination based research which have 8 treatments viz. T1 = 100% STB, T2 = T1 + 1 kg kitchen waste (decomposed) 6 kg-1 soil, T3 = 80% of T1 + 2 kg kitchen waste (decomposed) 6 kg-1 soil, T4 = T1 + 1 kg cowdung 6 kg-1 soil, T5 = 80% of T1 + 2 kg cowdung 6 kg-1 soil, T6 = T1 + 1 kg vermicompost 6 kg-1 soil, T7 =80% of T1 + 2 kg vermicompost 6 kg-1 soil & T8 = absolute control; and another is towards soil to organic materials ratio based research for safe food production in the rooftop garden consisting of 6 treatments viz.T1 = 1 kg kitchen waste for 1 kg soil, T2 = 1 kg kitchen waste for 2 kg soil, T3 = 1 kg cowdung for 1 kg soil, T4 = 1 kg cowdung for 2 kg soil, T5 = 1 kg vermicompost for 1 kg soil and T6 = 1 kg vermicompost for 2 kg soil. The experimental activities include fertilizer management of some vegetables, fruits and flowers; and influence of different ratio of soil and organic materials on the growth and yield of Bitter gourd for rooftop garden. Prior to setting the experiments initial soil samples as well as organic fertilizers were analyzed and nutrient statuses were determined. In case of 1st experiment, T7 treatment (80% of T1 + 2 kg vermicompost 6 kg-1 soil) showed best performance followed by T3 treatment (80% of T1 + 2 kg kitchen waste 6 kg-1 soil) for maximizing the yield of vegetables, fruits and flowers grown on the rooftop garden. In case of 2nd experiment,T5treatment (1 kg vermicompost for 1 kg soil) performed better in compared to others in the experiments related to influence of different ratio of soil and organic materials on the growth and yield of Bitter gourd for rooftop garden. The lowest yield was recorded from the T4 treatment (1 kg cowdung for 2 kg soil).

Efficacy of different form of urea on nitrogen availability and yield of Maize

R. Sen, M.M. Masud, A. Barman and H.M. Naser

The experiment was conducted at BARI, Gazipur during rabi season of 2021-22 with the objectives: i) to find out use efficiency of different form of urea, ii) to find out the yield and yield components of maize as influenced by different form of urea and iii) to analyze cost and return of maize produced from different form of urea. There were four treatments viz. T1: N-control, T2: RD of nitrogen (225 kg ha-1) in the form of Prilled urea, T3: Application of 200 kg nitrogen ha-1 in the form of urea super granule (USG), T4: Application of 205 kg nitrogen ha-1 in the form of neem coated urea. P, K, S, Zn & B were applied @ 60, 110, 40, 4 & 1.4 kg ha-1. The experiment was laid out in RCB design with three replications. The highest yield (10.75 t ha^{-1}) of maize was obtained from T3 treatment (200 kg N as USG) which was very close to T4 treatment

(10.69 t ha-1). The lowest yield (6.48 t ha^{-1}) of maize was noted in N-control treatment (T1).The actual nitrogen add (130 kg ha^{-1}), nitrogen uptake (162 kg ha-1) and nitrogen balance (-33 kg ha^{-1}) by maize was highest in T3 the treatment. If 1 kg extra nitrogen applied, 21.34 kg extra maize grain yield over N-control was observed in T3 treatment. If 1 kg extra nitrogen applied, 0.32 kg extra nitrogen uptake by maize over N-control was observed in T3 treatment. Cost and return analysis revealed that highest gross margin (72153 tk. ha^{-1}) as well as MBCR of 7.0 was obtained from T4 treatment (Neem coated urea applied maize plot). BCR in prilled urea and USG applied maize were 6.9 and 5.2, respectively.

Nutrient management of sesame in Barishal region

M.R. Islam and M.R. Uddin

A field experiment was conducted at Regional Agricultural Research Station, Rahmatpur, Barishal during April 2021 to June 2021 to develop nutrient management package for sesame in this region and to increase the yield of sesame through fertilizer management practice. The crop variety was BARI Til-4. There were five treatments viz. T0: Native fertility, T1:50:20:40:10:1:2 kg/ha NPKSZn & B (FRG-2018), T2: Farmers practice (40:15:20 k/ha NPK) , T3: 75% of T1+ CD 5t/ha, T4: 125% of T1, which were replicated for four times. Cowdung was used with chemical fertilizers for T3 treatment. Chemical fertilizers had showed significant influences on plant height (cm), shoot and root dry weight, number of pod /plant, as well as yield of sesame. The highest seed yield was obtained from T4 (901.50 kg ha-1) treatment which was statistically similar with T1 (887.25 kg ha-1) treatment and significant over T0 (608.0kg ha-1) and T2 (649.50 kg ha-1) treatments. Use of chemical fertilizer found better in sésame cultivation in Barishal region (Non–calcareous Grey Floodplain Soils under AEZ 13).

Effect of kitchen waste compost on soil carbon accumulation and Tomato yield

M. Yasmin, F.S. Shikha, M.A. Rahman, R. Sen and H.M. Naser

Two years field study was conducted on the effect of kitchen waste compost on tomato yield and carbon accumulation in soil at Regional Agricultural Research Station (RARS), Jamalpur, Bangladesh under Old Brahmaputra Floodplain (AEZ 9) during rabi season of 2020-2021 and 2021-2022.The objectives was to evaluate the effect of kitchen waste compost for better yield of tomato and to improve the stock of organic carbon in soil. The experiment was laid out in a randomized complete block design (RCBD) with 3 replications and BARI tomato-21 was used as test crop. There were seven treatments comprising T1 = 100 % RDCF (control), T2=100 % RDCF + Kitchen Waste Compost @ 2.5 t ha-1 , T3 = 100 % RDCF + Kitchen Waste Compost @ 5 t ha-1, T4 = 85% RDCF + Kitchen Waste Compost @ 2.5 t ha-1, T5 = 85% RDCF + Kitchen Waste Compost @ 5 t ha-1 , T6 =70% RDCF + Kitchen Waste Compost @ 2.5 t ha-1 and T7 = 70% RDCF + Kitchen Waste Compost @ 5 t ha-1. Data revealed that, combined application of kitchen waste compost and chemical fertilizer increased tomato production as compared to sole application of chemical fertilizers. The highest average tomato fruit yield (68.46 t ha-1) was found in T3 treatment (100 % RDCF + Kitchen Waste Compost @ 5 t ha-1). T1 treatment (100% RDCF) produced tomato yield of 55.82 t ha-1 which indicated that sole application of chemical fertilizer could not supply enough nutrients to plants. On the other hand, tomato yield was gradually decreased with decreasing chemical fertilizers. The lowest average

tomato yield of 52.73 t ha-1 was recorded in the T6 (70% RD + Kitchen Waste Compost @ 2.5 t ha-1) treatment. Soil organic matter and N, P, K contents of post-harvest soils were improved in integrated treatment compare to sole chemical treatment. Integrated treatment also increased organic carbon content, carbon stock and carbon accumulation in soil. So, application of100% recommended dose of chemical fertilizer with Kitchen Waste Compost @ 5 t ha-1 can be practiced for achieving higher tomato yield as well as economic benefit and keeps the soil and environment free from pollution.

Nutrient management through compost and Tricho compost on the growth and yield of Garlic in Jamalpur

F.S. Shikha, M. Yasmin , M.A. Rahman, R. Sen and H.M. Naser

A field trial was conducted at Regional Agricultural Research Station (RARS), Jamalpur during the period of 2020 - 2022 to develop an optimum and economic tricho compost dose for maximizing the yield of garlic. There were five treatments comprising T1 = 100% NPKSZnB (STB), T2 = Cowdung (3 t/ha.) + IPNS basis NPKSZnB , T3 = Tricho compost (4 t/ha.) + IPNS basis NPKSZnB, T4 = Tricho compost (2 t/ha. + IPNS basis NPKSZnB) and T5 = Native fertility. The highest average yield (9.41 tha -1) was obtained from T3 (Tricho compost (4 t/ha.) + IPNS basis NPKSZnB) treatment which was followed by T2 (Cowdung (3 t/ha.) + IPNS basis NPKSZnB.) treatment and the lowest (4.62 t ha -1.) from T5 (Native fertility) treatment. The highest individual bulb wt. (20.77 g) was obtained from theT3 (Tricho compost (4 t/ha.) + IPNS basis NPKSZnB) treatment) treatment which was statistically identical with T2 (Cowdung (3 t/ha.) + IPNS basis NPKSZnB) treatment. The lowest individual bulb wt.(7.38 g) was obtained fromT5 (Native fertility) treatment. Considering economics of the different treatments, the highest gross return (282300 TK ha-1), gross margin (160200 TK ha-1) and BCR (2.31) were obtained from T3 treatment i.e., tricho compost (4 t/ha.) along with chemical fertilizer. The lowest gross return (138600 TK ha-1) was found from T5 i.e., native fertility treatment. From the trial, it can be concluded that tricho compost along with IPNS based chemical fertilizers is the best treatment.

Nutrient management through organic manuring and biofertilizers on the yield of Onion and soil health improvement

F.S. Shikha, M. Yasmin, M.A. Rahman, R. Sen and H.M. Naser

A field trial was conducted during the period of 2020-21 and 2021-22 at Regional Agricultural Research Station (RARS), Jamalpur to increase yield of onion using tricho compost and arbuscular mycorrhizal fungi to obtain a good economic return with good soil health for the onion cultivation. There were six treatments comprising T1 = 100% NPKSZnB (STB), T2 = Tricho compost (5t/ha.) + IPNS basis NPKSZnB, T3 = Tricho compost (5t/ha.) + IPNS basis NPKSZnB +AM, T4 = 100% NPKSZnB (STB) + AM , T5 = Tricho compost (5t/ha.) + AM, T6 = Native fertility. The highest average bulb yield (22.65 tha-1) of onion was obtained from T3 (Tricho compost (5t/ha.) + IPNS basis NPKSZnB +AM) treatment. The lowest average bulb yield (9.14 tha-1) obviously recorded from control (T6) treatment. The highest bulb wt. (62.05 g) was obtained T3 (Tricho compost (5t/ha.) + IPNS basis NPKSZnB +AM) treatment and lowest

(40.54 g) was obtained from T6 (native fertility) treatment. The highest root colonization and no. of spore population (80%) and (353) respectively was observed in the trial treated with tricho compost-AM combined application, while the lowest values (30%) and (70) respectively were recorded in the control trial. The pH of post-harvest soil was affected by different treatments and ranged from 7.1 to 7.4. The macronutrient and micronutrient uptake significantly increased over STB fertilizer dose by the application of tricho compost and AM along with STB fertilizer dose. Maximum organic carbon (0.82%) was found from application of tricho compost and AM with STB fertilizer and minimum (0.73%) in control treatment. Soil total nitrogen varies from 0.041% to 0.047%. Likewise, remarkable increases of P and K in the T3 in comparison to the control. The soil organic carbon stock and carbon accumulation values (17.34 t ha-1 and 1.35 t ha-1) respectively are higher recorded in T3 (Tricho compost (5t/ha.) + IPNS basis NPKSZnB +AM) treatment and the lower values were recorded in T5 and control treatment. Considering economics of the different treatments, the highest gross return (679500 TK ha-1), gross margin (530420TK ha-1) and BCR (4.56) were obtained from T3 treatment i.e., tricho compost (5t/ha.), AM along with chemical fertilizer. The lowest gross return (274200 TK ha-1) was found from T6 i.e., native fertility treatment and lowest BCR (2.51) was obtained in T6 treatment. From the trial, it can be concluded that tricho compost and AMF inoculant along with IPNS based chemical fertilizers is the best treatment.

Effect of integrated nutrient management on the yield and nutrient uptake of Foxtail Millet

I.S.M. Farhad, F.S. Shikha, H.M. Naser, R. Sen, M.M. Masud, M.M. Sultana and A. Barman

A field experiment was conducted at Central Research Farm, BARI, Gazipur and Regional Agricultural Research Station (RARS), Jamalpur during Rabi season of 2019-22 to evaluate the effect of integrated nutrient management for better yield of foxtail millet; and to increase soil fertility and sustain crop productivity. Six treatment combinations viz. T1 = Soil test based fertilizer dose for HYG, T2= IPNS with 5.0 t ha-1 cowdung, T3 = IPNS with 5.0 t ha-1 compost, T4 = IPNS with 1.5 t ha-1 vermicompost, T5 = IPNS with 3.0 t ha-1 poultry manure and T6 = Native fertility were tested. The experiment was laid out in a randomized complete block design with 3 replications and BARI Kaon-2 was used as the test crop. The IPNS treatment combinations are significantly different from rest of the treatments in terms of yield and economic return. Application of treatment IPNS with 1.5 t ha-1 vermicompost significantly increased all of the parameters such as the plant height, number of tillers plant-1, panicle length, 1000 grain weight, grain yield and straw yield. The significantly highest grain yield (2.38 t ha-1 and 2.26 t ha-1 at Gazipur and Jamalpur, respectively) was recorded in IPNS with 1.5 t ha-1 vermicompost treated plot (T4) while the lowest grain yield (1.23 and 1.19 t ha-1 at Gazipur and Jamalpur, respectively) was observed in T6 (Native fertility) treatment. The uptake of nutrients by foxtail millet was highest in the treatment T4 receiving IPNS with 1.5 t ha-1 vermicompost which was followed by T5 (IPNS with 3.0 t ha-1 poultry manure) in both the locations. The highest gross return (132010 Tk. ha-1 and 126060 Tk. ha-1 at Gazipur and Jamalpur, respectively), net return (73700 Tk. ha-1 and 68545 Tk. ha-1 at Gazipur and Jamalpur, respectively) as well as BCR (2.26 and 2.19 at Gazipur and Jamalpur, respectively) were obtained from T4 treatment (IPNS with 1.5 t ha-1 vermicompost) whereas the lowest gross return (70400 Tk. ha-1 and 68020 Tk. ha-1 at Gazipur and Jamalpur, respectively), net return (27300 Tk. ha-1 and 25720 Tk. ha-1 at Gazipur and Jamalpur, respectively) and BCR (1.63 and 1.60 at Gazipur and Jamalpur, respectively) were obtained from T6 (Native fertility) treatment.

The overall results indicated that IPNS with 1.5 t ha-1 vermicompost is more effective than other fertilizer management packages in respect of yield as well as economic return for foxtail millet cultivation at Gazipur and Jamalpur.

Effect of different form and doses of urea fertilizer on nitrous oxide emission, nitrogen use efficiency and yield of Cauliflower

M.R. Khatun, R. Sen, A. Barman, M.M. Masud, M.M. Sultana and H.M. Naser

The experiment was conducted at BARI, Gazipur during rabi season of 2020-2021 with the objectives: i) to find out use efficiency of different form & rate of urea, ii) to find out the yield and yield components of cauliflower as influenced by different form & rate of urea and iii) to analyze cost and return of cauliflower produced from different form & rate of urea. There were ten treatments viz. T1: 100 kg N ha-1 in the form of Prilled Urea (PU), T2: 140 kg N ha-1 in the form of Prilled Urea (PU), T3: 180 kg N ha-1 in the form of Prilled Urea (PU), T4: 100 kg N ha-1in the form of Neem Coated Urea (NCU), T5: 140 kg N ha-1 in the form of Neem Coated Urea (NCU), T6: 180 kg N ha-1 in the form of Neem Coated Urea (NCU), T7: 100 kg N ha-1 in the form of Urea Super Granules (USG), T8: 140 kg N ha-1 in the form of Urea Super Granules (USG), T9: 180 kg N ha-1 in the form of Urea Super Granules (USG), T10: N-control. P, K, S, Zn & B were applied @ 60, 90, 20, 3 & 1.5 kg ha-1. The tested crop and variety was cauliflower (Snow white).The experiment was laid out in RCB design with three replications. The highest yield of cauliflower (42.44 t ha-1 was observed in T9 treatment (180 kg N ha-1 as USG applied) which was very close to the yield of 42.04 t ha-1 and it was found in T6 treatment (180 kg N ha-1 as NCU applied). The lowest yield (12.57 t ha-1) of cauliflower was noted in N-control treatment (T10). Highest agronomic use efficiency of nitrogen (166) was obtained from T9:180 kg N ha-1 as USG treated plot. Highest yield increase over control (238%) was also obtained from T9:180 kg N ha-1 as USG treated plot which was very close to T6 treatment (180 kg N ha-1 as NCU treated plot) yield increase about 234%.Cost and return analysis revealed that the highest gross margin(3,32,019/- Tk ha-1) as well as BCR (4.76) was obtained from T6 treatment (180 kg N ha-1 as NCU applied).

Effect of different organic manures on carbon accumulation in soil and yield of crops in Mustard-Mungbean-T.aman cropping pattern

M.R. Khatun, A. Barman, I.S.M. Farhad, M.M. Masud, M.M. Sultana and H.M. Naser

A field experiment on effect of different organic manures on carbon accumulation in soil and yield of crops in Mustard-Mungbean-T.aman rice cropping pattern was conducted at Gazipur (AEZ-28) during the year of 2020-22 with the objectives: to increase soil organic carbon, improve soil fertility and increase sustainable yield of the crops. There were nine different treatments viz. T1: 5 t ha-1 VC + IPNS,T2: 7.5 t ha-1 VC + IPNS, T3: 5 t ha-1Bioslurry + IPNS, T4: 7.5 t ha-1Bioslurry + IPNS, T5:5 t ha-1 Compost + IPNS, T6:7.5 t ha-1 Compost + IPNS, T7: 5 t ha-1 PM + IPNS, , T8:7.5 t ha-1 PM + IPNS, T9 : Native fertility. The experiment was laid out in RCB design with three replications. Tested crops and varieties were mustard (var. BARI Sarisha-17), mungbean (BARI mung 6) and T. aman (BRRIdhan 75). Data revealed that

the yield contributing characters and grain yield of mustard, mungbean and T. aman was significantly influenced by different IPNS treatments. The highest grain yields of mustard (1.88 t ha-1), mungbean (1.45 t ha-1) and T. aman (5.31 t ha-1) was found in T4 treatment where 7.5 t ha-1Bioslurry with IPNS basis inorganic fertilizers was applied. Total rice equivalent yield of the crops (12.74 t ha-1) was also highest in T4 (7.5 t ha-1 Bioslurry + IPNS) treatment.Cost and return analysis showed that, the highest gross return (2,54,800/- Tk ha-1) and highest gross margin (1,34,637/- Tk ha-1) were noted in T4 (7.5 t ha-1Bioslurry + IPNS) treatment but the highest BCR (2.18) was found in T3 (5 t ha-1Bioslurry + IPNS) treatment.

Effect of vermicompost on Groundnut yield and soil fertility in Charland

M. Yasmin, F.S. Shikha, M.A. Rahman, R. Sen and H.M. Naser

The experiment was conducted at farmers' field of Nouvanger char, Jamalpur Sadar, Jamalpur during the rabi season of 2020-2021 and 2021-2022.The objectives was to find out the effect of vermicompost with chemical fertilizer on groundnut yield, to increase soil fertility and to improve the stock of organic carbon in soil. The experiment was laid out in a randomized complete block design (RCBD) with 3 replications and BARI Chinabadam - 9 was used as test crop.There were seven treatments comprising, T1 = 100 % RDCF(control), T2 = 100 % RDCF + vermicompost @ 1 t ha-1, T3 = 100 % RDCF + vermicompost @ 3 t ha-1, T4 = 85% RDCF + vermicompost @ 1 t ha-1, T5 = 85% RDCF + vermicompost @ 3 t ha-1, T6 = 70% RDCF + vermicompost @ 1 t ha-1and T7 = 70% RDCF + vermicompost @ 3 t ha-1. Two years average data revealed that, combined application of vermicompost and chemical fertilizer increased groundnut yield and BCR as compared to sole application of chemical fertilizers. Among the treatments, T5 (85% RDCF + VC @ 3 t ha-1) produced the highest average nut yield (2.16 t ha-1) which was 19.33 % higher over 100% RDCF dose. On the other hand, groundnut yield was gradually decreased with decreasing chemical fertilizers. The lowest average groundnut yield of 1.55 t ha-1 was recorded in the T6 (70% RD + vermicompost @ 1 t ha-1) treatment. Soil organic matter and N, P, K contents of post-harvest soils were improved in integrated treatment compare to sole chemical treatment. Integrated treatment also increased organic carbon content, carbon stock and carbon accumulation in soil. Considering the overall performance, farmers may be advised to cultivate groundnut in charland applying 85 % chemical fertilizer with vermicompost @ 3 t ha−1 application. This combination would enable farmers to increase productivity of groundnut so as to enhance farmers' income and livelihoods.

Effect of co-composting biochar on Cabbage- Indian spinach-T.aman productivity

M.M. Masud, R. Sen, M.M. Sultana, I.S.M. Farhad and H.M. Naser

A field study was conducted at BARI research field under Grey Terrace Soil (AEZ 28) from 2021-22 to investigate the effects of Co- Composting biochar (COMBI) on soil fertility, carbon sequestration and increase yield and nutrient uptake of Cabbage- Indian spinach- T.aman cropping pattern. The experiment consisted of randomized complete block design with six treatments i.e. 100% recommendation dose of chemical fertilizer (RDCF), 80% RDCF with 5 t ha-1 compost, 80% RDCF with 5 t ha-1 RHB, 80% RDCF with 5 t ha-1 COMBI or 3 t ha-1 COMBI and control. In this year, three crops harvested and found that, yield was increased by amending organic compound. The greater rice equvalant yield (REY) was found in T4 treatment (80% RDCF with 5 t ha-1 co-composting biochar (COMBI). Compare to control, more than 133% REY increase by using 80% RDCF with 5 t ha-1 COMBI. Application of 5tha-1 organic compound, ie compost, Biochar and COMBI the increment varied from 9 to 24 percent REY where COMBI gave the greater yield. In addition, 15% REY was increase when COMBI 3tha-1 applied into soil. The highest gross margin was obtained from T4 treatment with a BCR 6.99 but we do not add organic compound price in this year. Our results demonstrate that application of more stable component such as COMBI instead of easily degraded organic amendments seems to be a promising option to supply enough nutrients for the healthy growth and yield of cabbage Grey Terrace Soil (AEZ 28). For more confirmation, the trial need to continue in a same plot without any destroys.

Nutrient management of Onion to reduce storage rots

M.M. Sultana, G.M.M Bari, M.M. Masud, R. Sen and H.M.Naser

A field experiment in a randomized complete block design with three replications was conducted on onions (*Allium cepa* L.)(var. BARI Piaj-4) at Lakkha Research Station, Bangladesh Agricultural Research Institute (BARI), Rajshahi during the rabi season of 2021-2022to investigate the nutrient management of onion to reduce storage rots. The five rates of soil amendments were: T1= 100 % RD (FRG 2018), T2 = N60P30K80S20 Ca0Mg0 kg/ha, T3 = N80P50K100S30 Ca30Mg100 kg/ha, T4 = N100P70K120S40 Ca60Mg200 kg/ha, T5 = No application (control). Results revealed that the T1(100% RD) produced the highest yield (17.33 t ha-1) and the lowest yield (7.53 t ha-1) in native fertility treatment (T5). Disease incidence was recorded from storage of onion bulbs were found maximum in T1 and minimum amount was found in T5.

Development of fertilizer recommendation for Chilli with Onion intercropping system

I.S.M. Farhad, H.M. Naser, R. Sen, M.M. Masud, R. Khatun, M.M. Sultana and A. Barman

An experiment was conducted at Central Research Farm, BARI, Gazipur during Rabi season of 2021-22 to develop a fertilizer recommendation for chilli with onion intercropping system. Six treatment combinations viz. T1= 100% RDCF of chilli + 0% RDCF of onion, T2= 100% RDCF

of chilli +10% RDCF of onion, T3= 100% RDCF of chilli + 20% RDCF of onion, T4= 100% RDCF of chilli +30% RDCF of onion, T5= 100% RDCF of chilli +40% RDCF of onion and T6= 100% RDCF of chilli +50% RDCF of onion were tested. The experiment was laid out in randomized complete block design with 3 replications. Both chilli and onion significantly influenced by different treatment combinations. Significantly highest yield of chilli (12.21 t ha-1) and onion (8.18 t ha-1) were obtained from T6 treatment (100% RDCF of chilli +50% RDCF of onion) which was statistically similar with T5 treatment (100% RDCF of chilli +40% RDCF of onion). Chilli equivalent yield progressively increases with the increase of inorganic fertilizers. The results showed that T6 provided the highest CEY (22.02 t ha-1) followed by T5 (21.97 t ha-1).The highest net return (432028 Tk. ha-1) as well as BCR (4.69) were obtained from T5 treatment (100% RDCF of chilli +40% RDCF of onion) whereas the lowest net return (366661 Tk. ha-1) as well as BCR (4.30) were observed in T1 treatment (100% RDCF of chilli + 0% RDCF of onion). Though T6 treatment gave higher yield over all the treatments yet it showed lower BCR compared to T5 treatment due to higher cost involvement for inorganic fertilizer.

Effect of kitchen waste compost on Broccoli yield and carbon accumulation in soil

I.S.M. Farhad, H.M. Naser, R. Sen, M.M. Masud, R. Khatun, M.M. Sultana and A. Barman

A field experiment was conducted at Central Research Farm, BARI, Gazipur during Rabi season of 2021-22 to evaluate the effect of kitchen waste compost for better yield of broccoli; and to increase soil fertility and improve the stock of organic carbon in the soil. Six treatment combinations viz. T1= 100% RDCF, T2= 100% RDCF + Kitchen waste compost @ 2.5 t ha-1, T3= 100% RDCF + Kitchen waste compost @ 5.0 t ha-1, T4= 80% RDCF + Kitchen waste compost @ 2.5 t ha-1, T5= 80% RDCF + Kitchen waste compost @ 5.0 t ha-1 and T6=Native fertility were tested. The experiment was laid out in a randomized complete block design with 3 replications. Application of treatment 100% RDCF + Kitchen waste compost @ 5.0 t ha-1 significantly increased all of the parameters such as the plant height, curd length, curd circumference, marketable weight of single curd, sprout yield and curd yield. The significantly highest curd yield (15.40 t ha-1) was recorded in T3 treatment (100% RDCF + Kitchen waste compost @5.0 t ha-1) whereas the lowest curd yield (5.31 t ha-1) was observed from T6 (Native fertility) treatment. The uptake of nutrients by brocolli was highest in the treatment T3 receiving 100% RDCF + Kitchen waste compost @ 5.0 t ha-1 which was followed by T5 (80% RDCF + Kitchen waste compost @ 5.0 t ha-1) treatment. The highest gross return (462000 Tk. ha-1), net return (291202 Tk. ha-1) as well as BCR (2.70) were obtained from T3 treatment (100% RDCF + Kitchen waste compost @ 5.0 t ha-1) whereas the lowest gross return (159300 Tk. ha-1), net return (28700 Tk. ha-1) and BCR (1.21) were obtained from T6 (Native fertility) treatment. Application of kitchen waste compost along with chemical fertilizers slightly increased total N, available P, exchangeable K, available S and available Zn & B contents in post-harvest soil. It also slightly increased OC content, carbon stock & carbon accumulation in soil. The overall results indicated that 100% RDCF + Kitchen waste compost @ 5.0 t ha-1is more effective than other fertilizer management packages in respect of yield as well as economic return for brocolli cultivation at Gazipur district of Bangladesh.

Integrated potash management for Mustard

M. Yasmin, F.S. Shikha, M.A. Rahman, R. Sen and H.M. Naser

The experiment was conducted at Regional Agricultural Research Station (RARS), Jamalpur during the period of 2021-22.The objectives were to evaluate the effect of integrated potash management for better yield of mustard and to increase potassium uptake. The experiment was laid out in a randomized complete block design (RCBD) with 3 replications and BARI Sarisha-14 was used as test crop. There were six treatments comprising T1 = control, T2= STB fertilizer dose, T3 = STB+ rice husk ash @1 t ha-1, T4 = STB + rice husk ash @ 2 t ha-1, T5 = STB + rice straw compost @ 3 t ha-1and T6 = STB+ rice straw compost @ 5 t ha-1. Among the various treatments, the highest seed yield (1448 Kg ha-1) of mustard was obtained from treatment T4 receiving STB fertilizer dose with rice husk ash @ 2 t ha-1 and the lowest yield (568 Kg ha-1) was noted in control treatment. Cost and return analysis revealed that the highest gross margin (Tk 116820 ha-1) as well as BCR of 2.87 were recorded from T4 (STB + rice husk ash @ 2 t ha-1) treatment. Results also demonstrated that, use of organic amendment such as rice husk ash, rice straw compost in integrated potash management practices also increased the potassium uptake and improved post-harvest soil K status over control or sole STB fertilizer dose. The overall results indicated that integrated potash management package of STB with rice husk ash @ 2 t ha-1is more effective than other packages in respect of yield, economic return, nutrient availability and soil health.

Application of vermiwash on growth and quality of Tomato

M. Yasmin, F.S. Shikha, M.A. Rahman, R. Sen and H.M. Naser

The experiment was conducted at Regional Agricultural Research Station (RARS), Jamalpur during the period of 2021-2022 to investigate the effect of vermiwash on growth, yield and quality of tomato and to find out suitable foliar dose of vermiwash for optimizing the yield of tomato. There were five treatments comprising T1= Chemical fertilizer (CF) (control), T2= CF + foliar spray of 10 % vermiwash,T3 =CF + foliar spray of 20 % vermiwash,T4= CF + foliar spray of 30 % vermiwash,T5= CF + foliar spray of 40 % vermiwash. Nutrients of the treatments were formulated through IPNS system. Results revealed that, vermiwash treated tomato plants showed better growth and yield parameters than the control plants. The highest average tomato fruit yield (70.51t ha-1) was found in T3 treatment i.e., foliar spray of 20% concentration of vermiwash and the lowest (61.82 t ha-1) came from control. On the other hand, nutritional quality (moisture content, TSS, lycopene, β carotene and vitamin C) were seen to be higher in vermiwash treated treatment compared to control treatment. The study suggests that, 20% vermiwash could be used as effective foliar spray for eco-friendly and higher yield of tomato.

Development of fertilizer recommendation for Groundnut- Linseed intercropping system

F.S. Shikha, M. Yasmin, M.A. Rahman, R. Sen and H.M. Naser

A field trial was conducted at Regional Agricultural Research Station (RARS), Jamalpur during the period of 2021-2022 to develop a suitable and economic fertilizer dose for maximizing the yield for groundnut with linseed intercropping system. There were seven treatments comprising

T1 = 100% RDCF of groundnut+ 0% RDCF of linseed, T2 = T1 + 10% RDCF of linseed, T3 = T1 + 20% RDCF of linseed, T4 = T1 + 30% RDCF of linseed, T5 = T1+ 40% RDCF of linseed, T6 = T1 + 50% RDCF of linseed and T7= T1 + 60% RDCF of linseed. Significantly the highest yield (1.83a tha-1for groundnut and 1.17a t ha $^{-1}$for linseed) was obtained from T6 (T1 + 50% RDCF of linseed) treatment which was statistically identical with T5 (T1 + 40% RDCF of linseed) treatment for groundnut and T5 and T4 for linseed. The lowest yield (0.81 tha-1 and 0.55 t ha $^{-1}$ for groundnut and linseed respectively) from T1 (100% RDCF of groundnut+ 0% RDCF of linseed) treatment. The highest net return (163735 tk ha-1) was obtained from T6 = T1 + 50% RDCF of linseed treatment which was followed by T5 = T1 + 40% RDCF of linseed treatment (147705 tk ha^{-1}). But the highest BCR (2.31) was obtained from T6 = T1 + 50% RDCF of linseed treatment which was followed by T5 = T1 + 40% RDCF of linseed treatment (2.20) and the lowest net return (13800 tk ha $^{-1}$) from T1 = 100% RDCF of groundnut+ 0% RDCF of linseed treatment. Although the highest groundnut equivalent yield (2.80 t ha $^{-1}$) was obtained from T6 (T1 + 50% RDCF of linseed) treatment, BCR was higher than T7 (T1 + 60% RDCF of linseed) treatment due to higher cost of inorganic fertilizers.

Development of fertilizer recommendation for Knolkhol Maize intercropping system

R. Sen, I.S.M. Farhad, H.M. Naser, M.M. Masud, R. Khatun, M.M. Sultana and A. Barman

An experiment was conducted at Central Research Farm, BARI, Gazipur during Rabi season of 2021-22 to develop a fertilizer recommendation for maize with knolkhol intercropping system. Seven treatment combinations viz. T1 (100% RDCF of Maize + 0% RDCF of Knolkhol), T2 (100% RDCF of Maize + 10% RDCF of Knolkhol), T3 (100% RDCF of Maize + 20% RDCF of Knolkhol), T4 (100% RDCF of Maize + 30% RDCF of Knolkhol), T5 (100% RDCF of Maize + 40% RDCF of Knolkhol), T6 (100% RDCF of Maize + 50% RDCF of Knolkhol) and T7 (100% RDCF of Maize + 60% RDCF of Knolkhol) were tested. The experiment was laid out in randomized complete block design with 3 replications. Both maize and knolkhol significantly influenced by different treatment combinations. Significantly the highest yield of maize (8.86 t ha-1) and knolkhol (32.17 t ha-1) were obtained from T7 treatment (100% RDCF of Maize +60% RDCF of Knolkhol) which was statistically similar with T6 treatment (100% RDCF of Maize +50% RDCF of Knolkhol). Maize equivalent yield progressively increases with the increase of inorganic fertilizers. The results showed that T7 provided the highest MEY (30.30 t ha-1) followed by T6 (30.13 t ha-1). The highest BCR (3.87) were obtained from T6 treatment (100% RDCF of maize +50% RDCF of knolkhol) whereas the lowest BCR (3.16) were observed in T1 treatment (100% RDCF of maize + 0% RDCF of knolkhol). Though T7 treatment gave higher yield over all the treatments yet it showed lower BCR compared to T6 treatment due to higher cost involvement for inorganic fertilizer.

Integrated nutrient management of year round four Vine crops modal for a intensive rooftop garden

A. Barman, I.S.M. Farhad, M.M. Sultana, R. Khatun, M.M. Masud, R. Sen and H.M. Naser

The study was conducted in Gazipur (rooftop of Soil Science Division) during the year of 2021-2022. The experiment activities include Integrated Nutrient Management of year round 4 vine crops modal for a intensive rooftop garden based research which have 5 treatments viz. T1 =

100% STB (Soil Test Based Fertilization), T2 = 80% of T1 + (1:3) Kitchen waste compost and soil, T3= 80% of T1 + (1:3) Cowdung and soil, T4= 80% of T1 + (1:3) Vermicompost and soil& T5 = absolute control. Prior to setting the experiments initial soil samples as well as organic fertilizers were analyzed and nutrient statuses were determined. Vegetables (Bottle gourd) performed better in T4 treatment (80% of T1 + (1:3) Vermicompost and soil) compared to others in the experiments related to integrated nutrient management for growth and yield of Bottle gourd on rooftop garden. The lowest yield was recorded from the control treatment.

Study on soil properties variation through the soil profile in saline areas of seven upazilas of Satkhira district

O.A. Fakir, R. Sen, J. Alam and H.M. Naser

The spatial variability of salt accumulation through the soil profile was studied at seven locations covering seven upazila of Satkhira: Satkhira Sadar, Kolaroa, Assasuni, Tala, Kaligonj, Debhata and Shymnagar. Three locations were randomly selected from each upazila. From each location, soil samples were collected from five soil depths at D1 = 0-7 cm, D2 = 8-15 cm, D3 =16-23 cm, D4 =24-31 cm and D5 =32-39 cm. The highest value of EC was found to be 7.92 dSm-1 in Shymnagar at 16-23 cm Soil depth and the lowest 0.42d dSm-1 in Tala upazila for the same soil depth. In case of soil depth 24-31 cm and 32-39 cm, the highest value of EC was found to be 8.74 and 9.82 dSm-1respectively in Shymnagar while the lowest soil salinity for the same depths were observed in Tala upazila. All the soil depth mean pH value was neutral to slightly alkaline except in Debhata which was strongly alkaline. Most of the soils under study had very high to medium organic matter content that decreased significantly with increasing depths in various land uses. The highest value of sulphur was found 87.80 ppm in Satkhira Sadar at 0-7 cm soil depth and the lowest value was 37.09 ppm in Kolaroa at 24-31 cm soil depth. The results clearly reveal that the top soil of Saline areas is very much sensitive to salt stress and for studied chemical properties.

Utilization of banana peel fertilizer on increasing Tomato yield and improving soil fertility

M.R. Khatun, R. Sen, M.M. Masud, M.M. Sultana, A. Barman and H.M. Naser

Banana peel is an organic waste, which has nutrients that are useful for plants. A pot experiment on utilization of banana peel fertilizer on increasing tomato yield and improving soil fertility was conducted in the net house of Soil Science Division, BARI, Joydebpur, Gazipur during the year of 2021-2022with the objectives: i) to find out the effect of banana peel fertilizer on tomato yield, ii) to find out the nutrient uptake and to increase soil fertility by the application of banana peel fertilizer. There were six treatments viz. T1: 100% RDCF, T2: 100% RDCF + 10% Banana peel fertilizer, T3: 100% RDCF + 20% Banana peel fertilizer, T4: 80% RDCF + 10% Banana peel fertilizer, T5: 80% RDCF + 20% Banana peel fertilizer, T6: Native fertility. The tested crop and variety were tomato (BARI tomato 16).The experiment was laid out in CRD design with four replications. Growth and yield of tomato were significantly influenced by different treatments. The highest yield of tomato (58.2 t ha-1) was observed in T3 treatment (100% RDCF + 20% Banana peel fertilizer) which was very close to the yield of 53.5 t ha-1and it was found in T2 (100% RDCF + 10% Banana peel fertilizer) treatment. The lowest yield (5.5 t ha-1) was noted in control treatment (T1). Highest yield increase over control (91%) was also obtained from T3: 100% RDCF + 20% Banana peel fertilizer treated pot which was very close to T2

treatment (100% RDCF + 20% Banana peel fertilizer treated pot) yield increase about 90%. Nutrient uptake was also influenced by banana peel with chemical fertilizers treatments. NPKS uptake in tomato was highest by T3 treatment.

Sustainable substrate composition as influenced by organic amendment on Dragon fruit in an extensive green roof

M. A. Rahman, F.S. Shikha, M. Yasmin and H.M. Naser

Green roof substrates are an artificial mixture of compounds designed to provide proper conditions for plant growth. A study was done to assess the improvement of soil-substrate properties and dragon fruit growth and yield at the rooftop of the laboratory building in Regional Agricultural Research Station (RARS) under Jamalpur Sadar upazila. There were nine treatment combinations- control (only farm soil), and the rest eight organic amendments (biochar and vermicompost). The rates of biochar and vermicompost were 0, 30 and 40% of the total substrate volume. The results demonstrate that substrate moisture content, plant canopy and plant dry matter content increased in biochar and vermicompost treated soil over non amended soil. It appeared that substrate moisture content was increased with the increase of the rate of biochar and vermicompost. Crop response study showed that the use of 30% biochar plus 30% vermicompost with farm soil produced a significantly higher plant canopy and plant dry matter content over the treatments. The use of biochar and vermicompost with farm soil produced a 12-73 % at North-South and 32- 53 % at East-West direction plant canopy and that was 1-87 % for dry matter content.

Fertilizer requirements for double rice cropping (T. Aus –T. aman rice system) pattern on saline soils at South Coastal region of Bangladesh

S. Akhter and M.F.A. Anik

A field experiment was conducted during kharf-I and kharif-II season 2020-2021in the farmers field at khatail, Dacope, khulna under the supervision of Soil Science Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur to find out the best fertilizer doses for cultivating T.aus-T.aman rice cropping pattern and also monitor the soil fertility status. The experiment was laid out in RCBD with three replications. There were six treatments viz. T1: 0 (control), T2: 100% RD (STB), T3: 120% RD of NPZn (STB), T4: 120% RD of N (STB), T5: 120% RD of P (STB)and T6: 120% RD of Zn (STB). In comparison to all other treatments, yield contributing traits and rice yield performed better in plots which were treated with 120% of recommended dose of NPZn. In the T.aus-T.aman rice cropping pattern, the 120% recommended dose of NPZn applied plots produced the highest grain and straw yield (Grain 5.28 t/ha and 5.44 t/ha., Straw 6.89 t/ha and 6.92 t/ha)compared to all other treatment combinations. Harvest Index (%) was also higher in the same treatment in both T.aus and T.aman rice cultivation. In terms of all parameters of the rice-rice cropping pattern, the T1 (Control) treatment performed worst in the south coastal region of Bangladesh.

Development of functionalized biochar and their characterization

M.M. Masud, A. Barman, S. Mia and H.M. Naser

Fertilizer use efficiency in agricultural systems of Bangladesh is often quite low due to low reactive surfaces of our soils. An increment in soil reactive surfaces can increase nutrient use efficiency while nutrient binding directly to reactive surfaces could further enhance it. Biochar, a pyrolysized biomass, can be used for developing such reactive surface blended fertilizer. In this experiment, biochar enriched fertilizers will be tailored blending function specific biochars with nutrients. To achieve these objectives, we first developed technologies to produce biochar with variable surface charges (positive, neutral and negative). Next, different biochars (pre-doped, post-doped, normal biochar) were produced following the developed methods while normal biochar was modified using chemical with hydrogen peroxide and biological with composting and incubation with soil inoculants and nutrients. The produced biochars were then characterized using Fourier Transform Infrared Spectroscopy (FTIR), cation exchange capacity (CEC), potentiometric charge determination and nutrient concentration analysis. Based on the results, several biochars were selected for biochar enriched N and composite fertilizer preparation. Next, a pre-trial was made to determine the formulation composition using different ratios of biochar, nutrient and additives. The quality (firmness and stability) of the pellets are examined and best mixing ratio was selected.

Modeling climate change impact on agriculture and developing mitigation and adaptation strategies for sustaining agricultural production in Bangladesh

S. Akhter, R. Sen, M. Haque

Climate change is a concern for future agriculture in Bangladesh. Frequencies of extreme climate events are increasing and damaging agricultural sectors severely. It requires understanding such events and mapping out the risks and impact of climate change (CC) on agriculture, nature and extent of climate variability/CC and vulnerability of crops and natural resources for adaptation. The “Modeling Climate Change Impact on Agriculture and developing mitigation and adaptation strategies for sustaining agricultural production in Bangladesh “(MCCA) project is working on this aspect which is being funded by KGF, Bangladesh. A group of scientists from BARI, BRRI, and BSMRAU together with KGF were involved in implementing the activities of CRP-II of KGF for three years (2015-2018). Now, this project was extended from December 2020-November 2023 as the 2nd phase. It is a collaborative project involving two NARS Institutes including BARC, BARI and BRRI; two universities including BAU and BSMRAU. The KGF funding project MCCA is being coordinated by BARC. Soil Science Division, BARI leads the Objective -4 of the project. Under this objective, some activities were done to fulfill the objectives.

Validation of crop intensification technologies for improving system productivity, soil health and farm income in South Central Coastal region.

S. Akhter, F. Alam and A. Barman

This coordinated project of NATP-2 (PBRG 051) was implemented jointly by Soil Science Division (SSD) and Oilseed Research Center (ORC), Bangladesh Agricultural Research Institute (BARI) collaborated with Agrarian Research Foundation (ARF) component started from January, 2019. Three components were conducted research on validation of crop intensification of three major cropping pattern in which two cropping pattern were executed in Goplalganj (Goplalganj Sadar, Kasheani upazilla), Madaripur (Madaripur sadar, Kalkini upazilla), Pirojpur (Pirojpur Sadar, Vandaria), and another one pattern was executed in Barishal (Babugonj, Gouronodi), Bagerhat (Bagerhat sadar, Mollarhat) and Jhalakati (Jhalakati Sadar, Rajapur upazilla) for the target of improving system productivity, soil health and farm income.The baseline survey was completed for existing crops practiced by the local farmers. After baseline survey, three crop based cropping pattern were introduced like Mustard-Mungbean-T.aman and Kheshari-Gimakolmi-T.aman at Goplalganj, Madaripur and Pirojpur region against the existing two or single crop based cropping pattern like Rabi-Jute-Fallow or Rabi-Fallow-T.aman or Rabi-Boro-Fallow or Boro-Fallow-Fallow. In Barishal, Bagerhat and Jhalakati location, the cropping pattern was Sweet gourd-Sesame-T. aman. By June 2022, the Soil Science Division, BARI component conducted experiments starting with the mungbean and gimakolmi crops in Kharif-1 season and harvested with good yield. From the first and second year trial, it was observed that IPNS based fertilizer application performed better than farmers practice with BARI Gimakolmi-1 yield 15% higher than local varieties. Among the mungbean varieties, BARI-Mung-6 yield better than BINA Mung-8 and BARI Mung-8. The second crop T. aman in both the cropping pattern was transplanted in last week of July 2019 and harvested at full maturity in October 2019. Among the three T. aman rice varieties, the variety BRRI dhan71 resulted better than BRRI dhan57, and BRRI dhan75 in all fertilizer levels. Among the three Mustard varieties, the variety BRRI mustard-17 resulted better than others variety and among the three khesari, Till and sweet gourd variety BARI Khesari-3, BARI Till-3 and BARI Hybried mistikumra-3 resulted better than others variety in all fertilizer levels. Highest total rice (system) yield of was obtained from IPNS based fertilizer management. Also highest gross margin and BCR were obtained from IPNS based fertilizer management.

Micronutrient Aspects of Soil Management

Nano scale zinc oxide particles for improving yield and quality of Tomato

H.M. Naser, S. Sultana, M. Akter, and M.B. Banu

A field experiment was carried out to study the effectiveness of soil and foliar application of Zn on the yield of tomato (Lycopersicon esculentum Mill.) at Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur, located at 23º59′26″ N and 90º24′52″ E. The micronutrients zinc (Zn) in the form of ZnO nanoparticles and zincsulphate heptahydrates ($ZnSO_4.7H_2O$) were applied as foliar spray at two different stages of plant growth i.e (i) before flower initiation; (ii) after fruit set when it becomes approximately marble sized. Significantly higher yield (94.5 and 94.2 t ha^{-1}) was produced, when plants were treated with $ZnSO_4$. $7H_2O$ @ 150 ppm and ZnO nano particles @ 15 ppm, respectively. Minimum fruit yield (78.2 t ha^{-1}) was produced by untreated plants - control. Comparatively lower yield was recorded in plants which sprayed with ZnO nanoparticles @ 10 ppm, (85.3 t ha^{-1}) than that of plants sprayed ZnO nanoparticles @ 15 ppm. Zinc supplied to the soil boosted yields, however they were lower than Zn nutrients foliar applied either ZnO nanoparticles or $ZnSO_4$, $7H_2O$. The increment of yield were 9.08 to 20.8, 0.34 to 6.18 and 1.37 to 7.63%, respectively over control, soil application ZnO nanoparticles and soil application of $ZnSO_4$, $7H_2O$. The treatment with 15 ppm of ZnO nanoparticles produced the highest levels of TSS (5.17 °Brix) and beta-carotene (23.3 $mg100g^{-1}$). Nanotechnology has provided better results than conventional method.

Effect of boron on yield and quality of Bitter gourd

M.B. Banu, M. Akter, S. Sultana and H.M. Naser

A field experiment was carried out to study the effect of boron on yield and quality of bitter gourd (cv. BARI Karola-4) at Soil Science Division, BARI, Joydebpur, Gazipur during kharif-I 2021 - 2022. The objectives of the study was to study the effect of B on number of flower setting and yield of bitter gourd; and to find out the optimum level of B for maximizing the yield and quality of bitter gourd. Design of the experiment was RCB with 3 (three) replications. The micronutrient boron (B) in the form of boric acid (H_3BO_3) having 17% boron were applied. The treatment combinations were T_1: Control, T_2: RDF (STB), T_3: 1.0 Kg B ha^{-1} + NPKSZn (STB), T_4: 1.5 Kg B ha^{-1} + NPKSZn (STB) and T_5: 2.0 Kg B ha^{-1} + NPKSZn (STB). The yield and yield contributing character of bitter gourd were significantly influenced by B application. All yield parameters showed higher tendency in T_4 treatment accept flower sheddings. The highest yield (24.52 t ha^{-1}) was observed in T_4 (1.5 Kg B ha^{-1}) treatment and it was significantly higher than control plants. Highest lowering of flower shedding (50.21%) was also observed in T_4 (1.5 Kg B ha^{-1}) treatment and it was higher than control plants. Nutrients concentration in bitter gourd was also influenced by B. P and K concentration was increased nonsignificantly while N concentration was increased significantly. The concentration of Zn was increased up to a certain level of B (1.5 kg ha^{-1}) then decreased. Nutrients uptake was maximum in the treatment where 1.5 Kg B ha^{-1} was added except K uptake. K uptake was maximum in T_5 treatment which was similar where 1.5 Kg B ha^{-1} was added. Application of B is effective for flower shedding, yield and quality of bitter gourd.

Foliar application of boron on reproductive growth of Sunflower

M.B. Banu, M. Akter, S. Sultana and H.M. Naser

Foliar application may be used to supply boron (B) to a crop when B demands are higher than can be supplied via the soil. A field experiment was carried out to study the foliar application of B on reproductive growth of sunflower (cv. BARI Surjamukhi-3) at Soil Science Division, BARI, Joydebpur, Gazipur (AEZ-28) during rabi 2021 - 2022. The objectives of the study was to determine the effect of foliar spray of B on yield contributing characters of sunflower and to find out the optimum rate of B for maximizing the yield and quality of sunflower. The experiment was laid out in RCBD replicated thrice. The micronutrient B in the form of boric acid (H_3BO_3) having 17% B were applied at 20-25 and 40-45 days after sowing (DAS). The treatment combinations of foliar spray of B were T_1: control (spray with distilled water), T_2: 50 mg L^{-1} B, T_3: 100 mg L^{-1} B and T_4: 150 mg L^{-1} B. The yield and yield contributing character of sunflower were significantly influenced by foliar application of B. All parameters showed higher tendency in T_4 treatment except number of empty seeds $head^{-1}$. The highest seed yield (2.27 t/ha) was observed in T_4 (150 mg L^{-1}B) and it was significantly higher compared with untreated plants. Lowest empty seed% (19.99%) was observed in T_4 (150 mg L^{-1}B) treatment. Foliar application of B is effective on reproductive growth of sunflower in the study area of Grey Terrace Soil of Gazipur (AEZ-28).

Effect of seed priming on yield and nutrient uptake of Cauliflower

S. Sultana, M. Akter, M.B. Banu and H.M. Naser

This study was conducted at the research field of Soil Science Division, Bangladesh Agricultural Research Institute (BARI),Gazipur under AEZ-28 during rabi season 2021-2022.A field experiment on effect of seed priming on yield and nutrient uptake of cauliflower was conducted in Grey Terrace Soil to determine concentration of seed priming on growth, yield and quality of cauliflower. There are six treatments viz. T_1: Control (without priming), T_2: Hydro priming (Seed soaked with distilled water), T_3: Seed soaked with 0.5% zinc, T_4: Seed soaked with 0.01% boron, T_5: Seed soaked with 0.5% zinc and 0.01% boron and T_6: Seed soaked with sand matrix. The experiment was RCB design with three replications. The combined use of micronutrients (Zn,B) seed priming gave the highest yield (56.8 t ha^{-1}). The same trend was observed in the yield contributing characters of cauliflower. The untreated treatment produced the lowest yield (25.4 t ha^{-1}). The highest zinc and boron uptake was found in T_5 treatment (seed soaked with zinc and boron).Quality characters like TSS, ascorbic acid and β carotene content also found high in combined use of seed priming treatments. The combined application of boron and zinc (0.01% + 0.5) for seed priming was the most effective treatment technique for cauliflower production.

Foliar application of manganese on growth and yield of Groundnut

S. Sultana, M. Akter, M.B. Banu and H.M. Naser

This study was conducted at the research field of Soil Science Division, Bangladesh Agricultural Research Institute (BARI), Gazipur under AEZ-28 during rabi season 2021-2022.A field experiment on effect of foliar application of manganese on growth and yield of groundnut was conducted in Grey Terrace Soil to determine the effect of manganese on growth, yield and quality of groundnut (BARI chinabadam 9). There are five treatments viz. T_1: Control, T_2: Foliar spray of 0.02% Mn, T_3: Foliar spray of 0.04% Mn, T_4: Soil application of Mn 0.5 kg ha^{-1}, T_5: Soil application of Mn 1.0 kg ha^{-1}. The experiment was RCB design with three replications. The highest nut yield (2.59 t ha^{-1}) was found in T_3 treatment. The same trend was observed in the yield contributing characters of groundnut. The untreated treatment produced the lowest yield (1.72 t ha^{-1}).Crude oil and protein% and micronutrient content also high in foliar treated treatments. The highest content of Mn, Fe, Zn and B was found in T_3 treatment (0.04% foliar applied Mn). Foliar application of manganese is an effective technology for increasing the yield and quality of groundnut.

Determination of critical limit of zinc for Chickpea

M. Akter, S. Sultana, M.B. Banu and H.M. Naser

A pot experiment was conducted to determine the critical limit of zinc for chickpea cultivation at the net house of Soil Science Division of Bangladesh Agricultural Research Institute, Gazipur during Rabi season of 2021-2022 grown in twenty soils collected from the five AEZs such as Tista Meander Floodplain (AEZ-3), Karatoya –Bangali Floodplain (AEZ-4), High Ganges River Floodplain (AEZ-11), Low Ganges River Floodplain (AEZ-12) and Madhupur Tract (AEZ-28). The experiment was laid out in a factorial and completely randomized design with two levels of Zn (0 and 5 ppm) applied to 20 different soil samples using three replications. The available Zn content of soils was estimated by the extraction method as 0.005 M Diethylene Triamine Pentaacetic Acid (DTPA). The amount of DTPA extractable Zn in different soils ranged from 0.50–3.1 mg kg^{-1}. The soils contained pH 4.27-7.57 and organic matter 0.67-1.87 %. The soil available Zn was negatively and significantly correlated with soil pH, Ca and Mg. However, the point below which chickpea shows Zn deficiency were 0.63 mg kg^{-1} in soils and 25.3 mg kg^{-1} in plant tissue as determined by Cate and Nelson's graphical procedure.

Effect of boron on yield and nutrient uptake of Mungbean

M. Akter, S. Sultana, M.B. Banu and H.M. Naser

A field experiment was carried out in Tista Meander Floodplain Soil (AEZ-3) at On Farm Research Division, Rangpur during Kharif 1 season of 2021- 2022. Boron deficiency has appeared as a serious threat to mungbean production in the northern part of Bangladesh. Supply of required amount of boron fertilizer is therefore needed to increase mungbean yield. The objectives were to study the effect of boron on yield and nutrient uptake of mungbean (BARI Mung 8), estimate optimum dose of boron for higher yield of mungbean and find out the boron use efficiency of mungbean. The experiment was designed in Randomized Complete Block Design (RCBD) with three replications. BARI Mung 8 with five levels of boron along with a blanket dose $N_{18}P_{18}K_{24}S_{12}Zn_2Mo_{0.8}$ was used in the study. Maximum seed yield was observed in

T_4 treatment (1.60 t ha^{-1}) by the application of 1.5 kg B ha^{-1} as compared to the other treatment. Highest boron uptake (0.026 kg ha^{-1}), highest B use efficiency (agronomic efficiency 280 and recovery efficiency 0.008) were found in the treatment having B at 1.5 kg ha^{-1} but highest B concentration (16.3 ppm) was found in 2 kg ha^{-1} B rate. BARI Mung 8 was performed better with application of 1.5 kg B ha^{-1} as compared to the other treatment.

Effect of foliar application of zinc in Sweet orange

M.M.H. Bhuiyan, M.A. Siddiky, M.O. Kaisar and H.M. Naser

Afield experiment was carried out to determine the efficiency of foliar application of Zn on sweet orange yield at Regional Agricultural Research Station, BARI, Cumilla in 2020-21. The experiment was laid out in Randomized Block Design (RCBD) with 4 treatments and three replications. Observations were recorded on the growth and yield parameters of sweet orange. The treatments were Zn @ 0, 500, 1000, and 1500 mg per liter. The results revealed that there were significant variations in the growth and yield of sweet oranges due to the foliar application of zinc. The values of vegetative growth parameters like plant height, fruit length, and diameter showed a non-significant effect by treatments but canopy volume, fruit number per plant, and individual fruit weight showed significant effect by the treatments. The chemical parameters of fruit like TSS (%) also showed a non-significant effect by foliar spray. But the fruit yield was influenced by the treatments and the highest yield (12.5 kg $tree^{-1}$) was recorded with Zn @1500 mg per liter and the lowest yield was noted in the control treatment i.e. Zn @ 0 mg per liter. This is the first year of the trial and the trial should be continued before making the final conclusion of the results.

Effect of boron fertilization on Lentil in Barishal region

M.R. Islam, M.R. Uddin and H.M. Naser

A field experiment was carried out at Regional Agricultural Research Station, Rahmatpur, Barishal during November 2020 to March 2021 and November 2021 to March 2022 to develop proper dose of boron fertilizer for lentil production in Barishal region of Bangladesh. The crop variety was BARI Masur-8. There were five treatments viz. T_0: 0.0 kg B/ha, T_1: 1.0 kg B/ha,T_2: 1.5 kg B/ha, T_3: 2.0 kg B/ha, and T_4 : 2.5 kg B/ha which were replicated for four times. Boron had influence on plant height (cm), number of branches, no of pods/plant, pods weight /plant, pod yield/ plant, stover yield, as well as seed yield of BARI Masur-8. The highest seed yield (1960 kg ha^{-1}) was observed in T_2 ($B_{1.5}$) treatment in 2020-2021 which was statistically identical to all other treatments except control and T_4 ($B_{2.5}$) treatment, but in 2021-2022 year, the highest seed yield (1459 kg ha^{-1}) was obtained from T_1 ($B_{1.0}$) treatment which was statistically significant with all other treatments except T_2 ($B_{1.5}$) treatment in Barishal region, (Non–calcareous Grey Floodplain Soils under AEZ 13).

Microbiological Aspects of Soil Management

Assessment of Arbuscular mycorrhizal association in some fruits and field crops

M.E. Ali, M.F.A. Anik, M. Rahman and H.M. Naser

Rhizosphere soils including fine roots of some field crops were collected from Pabna region during 2021-2022 for counting Arbuscular Mycorrhiza (AM) spore population and determining colonization (%) in their roots. The spore numbers of 100-gram rhizosphere soil were recorded ranging from 74.60 (Black cumin) to a maximum of 192.0 (Linseed). A considerable variation was observed in average spore numbers recorded in different field crops. Among the field crops, the highest root colonization (50.0%) was found in potato and linseed and lower colonization (10.0%) was found in some of the crops like cabbage, lentil, garlic etc.

Collection, isolation and screening of indigenous rhizobial strains for different legumes

M.E. Ali, M.F.A. Anik, M. Rahman and H.M. Naser

Nodules were collected from different legume crops grown under different locations in Bangladesh during 2022-2022. Eight legume crops namely grasspea, lentil, chickpea, mungbean, gardenpea, groundnut, soybean, and cowpea were selected for collecting nodules from different locations. Grasspea from five, lentil from eight, chickpea from seven, mungbean from one, gardenpea from two, groundnut from three, soybean from four and cowpea from three locations. Culture and sub-culture were done and preserved in the laboratory. Their infectivity test, laboratory and field study will be done.

Study on microbial population status in rhizosphere soils of different crops of some AEZs of Bangladesh

M.E. Ali, M.F.A. Anik, M. Rahman and H.M. Naser

Soil microbes play a major role in legumes to supply nutrient to plants as well as decomposition of organic materials and cycling of nutrients. Sixteen rhizosphere soil samples were collected from selected locations of different AEZs of Bangladesh to know the total bacteria, Rhizobium, Free living bacteria, Phosphate Solubilizing bacteria (PSB), Actinomycetes and Fungal population at different AEZs of Bangladesh. Rhizobium was grown in YMA media and Rhizobium colonies were counted. The highest total bacacteria (6.6×10^9 g^{-1} soil) was recorded in the rhizosphere soils of cabbage and the lowest number of total bacterial colony (1.0×10^7 g^{-1} soil) was observed in the the rhizosphere soils of bitter gourd and bottle gourd. The highest Rhizobium (9.2×10^8 g^{-1} soil) was found in the rhizosphere soils of Wheat and the lowest population (6.0×10^5 g^{-1} soil) was observed in the rhizosphere soils of Chilli. A free living bacterium was grown in N free media and colonies were counted. The highest free-living bacterial population (5.4×10^9 g^{-1} soil) was found in the rhizosphere soils of Bean and the lowest population (1.0×10^5 g^{-1} soil) was observed in the rhizosphere soils of Wheat and onion. Phosphate solubilizing bacteria was grown in Pikovskaya's media and PSB colonies were counted. The highest PSB population (1.6×10^9 g^{-1} soil) was found in the rhizosphere soils of

Tobacco and the lowest population (1.0×10^5 g^{-1} soil) was observed in the rhizosphere soils of Cauliflower. Actinomycetes were grown in Actinimycetes agar media and colonies were counted. The highest Actinomycetes population (8.0×10^7 g^{-1} soil) was found in the rhizosphere soils of Bean and the lowest population (1.0×10^5 g^{-1} soil) was observed in the rhizosphere soils of Tobacco. Fungus was grown in PDA media and colonies were counted. The highest fungal colonies (5.3×10^8 g^{-1} soil) was found in the rhizosphere soils of Tobacco and the lowest population (2.0×10^5 g^{-1} soil) was observed in the rhizosphere soils of Sugarcane and Sunflower.

Effect of Azotobacter on the growth and yield of Chilli

M.E. Ali, M.F.A. Anik and H.M. Naser

The experiment was carried out during Robi season of 2021 - 2022 in research field of Soil Science Division, BARI, Joydebpur, Gazipur to find out the effect of Azotobacter inoculum along with different doses of N fertilizer on growth and yield of Chilli. The experiment was designed in RCBD with 6 treatments and 4 replications. Chilli (BARI morich-2) was used as a test crop. Liquid azotobacter inoculum was used in this experiment. The population density of used inoculum was more than 10^8 cfu g^{-1} inoculant. There were six treatments viz. T_1: 100% N of Recommended Dose, T_2: 90% N + Azotobacter inoculum, T_3: 80% N + Azotobacter inoculum, T_4: 70% N + Azotobacter inoculum, T_5: Azotobacter inoculum and T_6: Control. Results of the experiment revealed that highest fruit yield of chilli (12.52 t ha^{-1}) found in T_3 treatments which was statistically identical with T_1 (12.27 t ha^{-1}) and T_1 (12.06 t ha^{-1}) treatment. This result suggested that use of azotobacter inoculum in combination with reduced dose of N fertilizer was beneficial for chilli and onion and we could reduce 20% of nitrogenous fertilizer.

Response of Lentil varieties to elite strains of *Rhizobium*

M E Ali, F. S. Shikha, M. Yasmin and M. A. Rahman

Field experiment was conducted at research field of Regional Agricultural Research Station (RARS), Bangladesh Agricultural Research Institute, Jamalpur, during 2021-2022 with the objectives to study the response of Rhizobium inoculation with different varieties of BARI released lentil. Four varieties of lentil viz. BARI Masur-6, BARI Masur-7, BARI Masur-8 and BARI Masur-9 and rhizobial inoculum (Rhizobium strain RLc-104) were used in this experiment. Unit plot size was 4 m x 3 m. The experiment was designed in randomized complete block having 3 replications in each treatment. Each variety was tested with/without Rhizobium inoculation. Inoculated plants gave significantly higher nodule number, nodule weight, shoot weight and seed yield compared to non-inoculated plants. Among 4 varieties, BARI Masur-8 produced the highest nodule number and nodule weight. The interaction effect revealed that the highest seed yield of 1.02 t ha^{-1} was recorded by inoculated BARI Masur-8.

Validation of biofertilizer on different legume crops

M.E. Ali, M.S. Rahman, M.M Rahman, J.A. Mahmud, M.F.A. Anik, M. Rahman and H.M. Naser

Field experiments by Rhizobium biofertilizer were carried out during rabi 2021-2022 at Kumerkhali, Kushtia on lentil, and On farm Research Station, Sherpur on Groundnut with the objectives i) to evaluate the response of pulse and oilseed legume to Rhizobium biofertilizer under farmers' field condition, and ii) to motivate uses of biofertilizer instead of N-fertilizer for pulse and oilseed legume cultivation. The experiment was laidout in RCBD with 4 dispersed replications. Unit plot size was 15 m × 10 m. Three fertilizer treatments viz. T_1: 22-42-20-5 kg P-K-S-Zn ha^{-1}, T_2: 22-42-20-5 kg P-K-S-Zn ha^{-1} + Rhizobium Inoculum and T_3: 50-22-42-20-5 kg N-P-K-S-Zn ha^{-1} was studied (N dose were different in respect of crops). BARI Masur-8 of lentil and BARI Chinabadam-9 of groundnut and peat based rhizobial inoculum (strain BARI RLc-104 for lentil and strain BARI RAh-803 for groundnut) @ 1.5 kg ha^{-1} were used in demonstration trial. Experimental result revealed that application of biofertilizer along with PKSZn produced higher seed yield and yield attributes of lentil at Faridpur lentil and groundnut at Jamalpur. It is evident from the experiment that application of biofertilizer instead of applying nitrogenous fertilizer can achieve the higher yield of lentil at farmers' field in Faridpur and groundnut in Jamalpur. Higher BCR was noted in T_2 treatment where Rhizobium plus chemical fertilizers (PKSZn) were used.

Effect of different biofertilizer on yield of Onion

M.E. Ali, M.F.A. Anik, M. Rahman and H.M. Naser

The experiment was carried out during Rabi season of 2021-2022 in the research field of Soil Science Division, BARI, Joydebpur, Gazipur to find out the effect of different biofertilizer inoculum along with different doses of N & P fertilizer on the yield of Onion. The experiment was designed in RCBD with 9 treatments and 4 replications. Onion (BARI piaj-4) was used as a test crop. Liquid azotobacter and phosphate solubilizing bacterial (PSB) inoculum was used in this experiment. The population density of Azotobacter and PSB inoculum were more than 10^8 cell ml^{-1} liquid inoculant. Arbuscular mycorrhiza (AM) was used in the seed bed while producing seedling There were nine treatments viz. T_1 : 100% NPKSZn of RD (Recommended Dose), T_2 : 80% N + *Azotobacter inoculum,* T_3 : 80% P + *PSB inoculum,* T_4 : 50% P + *AM inoculum,* T_5 : 80% NP +*Azotobacter + PSB,* T_6 : 80% N+ 50% P +*Azot.*, T_7 : 50% P + *AM+PSB,* T_8 : 80% N+ 50% P + Azot. +*AM+PSB and* T_9: Control. Results of the experiment revealed that the highest bulb yield of onion (23.77 t ha^{-1}) was found in T_7 (50% P + *AM+PSB*) treatments which was statistically identical with all other treatments except control. This result suggested that use of azotobacter PSB and AM inoculum in combination with reduced dose of N and P fertilizer was beneficial for onion in the Grey Terrace soils of Gazipur (AEZ 28) and we could reduce 20% of nitrogenous and 50% of phosphatic fertilizer. The experiment should be continued for confirming the findings.

Effect of Arbuscular mycorrhizal fungi and phosphorus on Broccoli

M.E. Ali, F. Alam, M.F.A. Anik, M. Rahman and H.M. Naser

A field experiment was conducted at Central Farm, Soil Science Division, Bangladesh Agricultural Research Institute, during rabi season of 2021-2022 with the objectives to study the effect of combined use of arbuscular mycorrhizal fungi and phosphorus on growth and yield of broccoli, and to reduce to use of P-fertilizer under field condition. The experiment was designed in factorial RCBD with six treatments and four replications. The cauliflower variety was snow white as test crop. Soil based arbuscular mycorrhizal (AM) inoculum and infected root pieces of the host plant were used at the rate of 1 kg soil m^{-2} in seedbed for producing broccoli seedlings. The treatment combinations were: T_1P_1U: 0% P × without AM, T_2P_2U: 50% P × without AM, T_3P_3U: 100% P × without AM, T_4P_1AM: 0% P × with AM, T_5P_2AM: 50% P × with AM, T_6P_3AM: 100% P × with AM. Mycorrhizal inoculation significantly increased root length (cm), root colonization (%), spore population (100 g^{-1} soil) and curd yield (t ha^{-1}). Collar diameter, Plant height (cm), Plant weight (kg), number of leaf (plant^{-1}), curd height (cm) and curd circumstances (cm) were non-significant. The plant that received AM in nursery bed produced higher curd yield than without AM in all phosphorus levels of broccoli. The highest broccoli curd yield 29.40 t ha^{-1} was recorded in 50% P with AM (AM was used in nursery bed) in Madhupur Tract soil (AEZ 28). The result indicates that inoculation of AM used in nursery bed can save 50% P in the field. The plant which did not receive AM in nursery bed produced lower yield in all phosphorus levels in the field.

Effect of Arbuscular mycorrhizal fungi, biochar and vermicompost on Maize (*Zea mays*) in saline soil

M. Rahman, M.E. Ali, M.F.A. Anik, M.M. Masud and H.M. Naser

The present study was carried out to evaluate the effect of indigenous Arbuscular Mycorrhizal Fungi (AMF), biochar, and vermicompost on growth parameters, biomass, colonization, and yield characters of maize in 8 dS m^{-1} saline soil. The experiment was carried out under pot culture conditions in the net house of Soil Science Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur in 2022. The experiment was designed in CRD with eight treatments and four replications. The ten treatments were T_1 : Control, T_2 : Arbuscular mycorrhiza (AM), T_3 : Biochar @10 t ha^{-1}, T_4 : Vermicompost@ 3 t ha^{-1},T_5 : AM + Biochar @ 5 t ha^{-1}, T_6 : AM + Biochar @ 10 t ha^{-1}, T_7 : AM + Vermicompost @ 3 t ha^{-1}, T_8 : AM + Vermicompost @ 6 t ha^{-1}, T_9 : Biochar @ 5 t ha^{-1} + Vermicompost @ 3 t ha^{-1} and T_{10} : AM + Biochar @ 5 t ha^{-1} + Vermicompost @ 3 t ha^{-1}. The result showed that AM + Vermicompost @ 3 t ha-1 treatment produced the highest growth parameters, biomass, colonization, and yield characteristics of maize in 8 dS m-1 saline soil, and the control treatment produced the lowest growth parameters, biomass, colonization, and yield characters of maize in saline soil. It was noticed that AM + Vermicompost @ 3 t ha-1 treatment (T7) produced the highest kernel yield (101.25 g pot-1, 91.94% higher over control) of maize which was significantly different from the rest of the treatments. Therefore, the combination mentioned above could sustain soil health, and ensure better growth and productivity in a saline environment compared to the other mixes.

Effect of Arbuscular mycorrhizal inoculation on Maize at different salinity levels

M. Rahman, M.E. Ali, M.F.A. Anik and H.M. Naser

Arbuscular mycorrhizal (AM) fungi increase host plants' tolerance to the different salinity levels. A pot experiment was carried out in the net house of Soil Science Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur, in 2022. The study's objectives were to evaluate the potentiality of arbuscular mycorrhizal inoculation on the plant height, leaf number, root colonization, spore population, yield, and yield attributes of maize treated with different salinity levels. The experiment was designed in factorial randomized completely block design with four replications. Five salinity treatments (0, 2, 4, 6 and 8 dSm^{-1}) possessed salinity levels as the first factor and the second factor consists of mycorrhizal and non-mycorrhizal treatments. Soil based mixed arbuscular mycorrhizal (AM) inoculum containing about approximate 252 ± 20 spores and infected root pieces of the host plant was used pot^{-1}. With increasing salinity concentration plant height, leaf number, root colonization, spore population, yield and yield attributes decreased significantly. It was observed that 0 dSm^{-1} + AM treatment produced the highest ear weight (101.75 g pot^{-1}) and kernel yield (58.50 g pot^{-1}) of maize. In contrast, 8 dSm^{-1} treatments produced the lowest ear weight (51.75 g pot^{-1}) and kernel yield (31.25 g pot^{-1}) of maize. The study indicates that mycorrhizal inoculation could reduce the harmful effects of salinity on the host plants, thus increasing plant survival and allowing the plants growth under extreme conditions.

Effect of biofertilizer, biochar and chemical fertilizers on yield and qualitative properties of Groundnut

M. Rahman, M.E. Ali, M.F.A. Anik, M.M. Masud and H.M. Naser

A field experiment was conducted at BARI Central Farm, Joydebpur, Gazipur to evaluate the effect of biofertilizer, biochar, and chemical fertilizers on groundnut yield and qualitative properties during the rabi season of 2021-2022. The crop variety was BARI Chinabadam-8, and the Rhizobium strain was BARI RAh-229. There were nine treatments, viz. T_1: Control (non-inoculated and non-fertilized), T_2: Biochar @ 5 t ha^{-1}, T_3: Biochar @ 10 t ha^{-1}, T_4: Biochar @ 5 t ha^{-1} + IPNS based NPKS, T_5: Biochar @ 10 t ha^{-1} + IPNS based NPKS, T_6: Biochar @ 5 t ha^{-1} + Rhizobium + IPNS based PKS, T_7: Biochar @ 10 t ha^{-1} + Rhizobium + IPNS based PKS, T_8: 100% NPKS, T_9: Rhizobium inoculant + 100% PKS which were replicated three times. The peat-based rhizobial inoculum was used at a 1.5 kg ha^{-1} as seed inoculant. The result showed that the highest nut yield (2.42 t ha^{-1}, 49.4% higher over control) and stover yield (4.09 t ha^{-1}) were observed in T_7 (Biochar @ 10 t ha^{-1} +Rhizobium+IPNS based PKS) treatment which was identical with the T_6 (Biochar @ 5 t ha^{-1} +Rhizobium+IPNS based PKS) treatment having nut yield and stover yield 2.40 t ha^{-1}(48.2% higher over control) and 3.81 t ha^{-1}, respectively. So, we can reduce biochar and inorganic fertilizer without affecting the quality and productivity of groundnut. From the trial, it can be concluded that Biochar @ 5 t ha^{-1}+Rhizobium+IPNS based PKS may be recommended for groundnut cultivation in Grey Terrace Soil of Joydebpur (AEZ-28).

Effect of biofertilizer and chemical fertilizers on soil microbial population status, nodulation pattern, nodule initiation date and yield of Grasspea varieties

M.F.A. Anik, M.E. Ali, M. Rahman and H.M. Naser

A field experiment was conducted at central farm of Bangladesh Agricultural Research Institute (AEZ-28) during rabi season 2021-2022 to evaluate the effects of biofertilizer and chemical fertilizer on soil microbial population status, nodulation pattern, nodule initiation date and yield of grasspea varieties. The experiment was designed in randomized complete block (RCBD) with 2 factors (fertilizer doses and varieties) having 3 replications in each treatment. Three fertilizer doses were 100% PKSZnB, *Rhizobium* + 100% PKSZnB, 100% NPKSZnB and three varieties were BARI khesari-3, BARI khesari-5 and BARI khesari-6. Unit plot size was 3 m x 2 m. There were 9 treatment combinations. Basic doses of fertilizers were 15-11-20-7-1-1 kg N-P-K-S-Zn-B ha^{-1}. All the fertilizers except N were applied as basal at final land preparation. N was applied in three equal splits at 10, 20 and 30 days after sowing. Peat based rhizobial inoculum (BARI RLs-10) @ 1.5 kg ha^{-1} was used for seed inoculation. Peat based rhizobial inoculum was used containing about 10^8 cells g^{-1} inoculum. From the investigated study, BARI khesari-5 has the greater ability to produce maximum number of nodule than all other varieties. In this experiment we found that grasspea varieties required 16-17 days for their first nodulation. The nodulation pattern trend was BARI khesari-5> BARI khesari-6> BARI khesari-3 at Gazipur during 2021-2022. In three varieties, nodule initiation was increased during the pre-flowering stages but decreases when it turns into reproductive stages. The better nodulation was observed after 73 days of grasspea seeds sowing specially at BARI khesari-5 varieties. 100% NPKSZnB and *Rhizobium* + 100% PKSZnB treated plot performed better than 100% PKSZnB treated plot. In respect of variety, BARI khesari-5 gave better results than others. Combined effects of fertilizer doses and varieties, *Rhizobium* + 100% PKSZnB with BARI khesari-5 and 100% NPKSZnB with BARI khesari-6 significantly gave the highest straw yield and seed yield at Gazipur. In case of microbial population status, *Rhizobium* + 100%PKSZnB treated plot showed the maximum number of populations in Gazipur during 2021-2022. *Rhizobium* + 100% PKSZnB and 100% NPKSZnB with BARI kheasri-5 and BARI khesari-6 showed the maximum nutrient uptake from soil. All the nutrients during grasspea production exhibited the negative apparent nutrient balances at Gazipur during 2021-2022.

Isolation of Phosphate Solubilizing Bacteria (PSB) and their efficacy on the growth of Barley

M.F.A. Anik, M.E. Ali, M. Rahman and H.M. Naser

A pot experiment was conducted during rabi season 2021-2022 at the net house of Soil Science Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur to isolate the phosphate solubilizing bacteria (PSB) and their performance on the growth of barley laid out in RCBD with three replications. There were five treatments viz. T_1= Control, T_2= PSB isolate I (AEZ-29), T_3= PSB isolate II (AEZ-03), T_4= PSB isolate III (AEZ-11) and T_5= PSB isolate IV (AEZ-09). The four isolated PSB strains containing about 10^8cells g^{-1} inoculum. Among five different treatment combinations, T_4 (PSB isolate III, AEZ-11) performed better than others. The germination percentage (97.16%) and seedling vigor index (3588) exhibited the better results significantly in T_4 treatment. In different growth parameters of barley like plant height (75.94

cm), root length (21.53 cm), root weight (397.52 mg), no. of tiller per hill (2.30), no. of spikes per hill (2.13), no. of kernel per spike (45.83), spike length (15.40 cm) and no. of filled kernel per spike (41.03) also showed the superior results in the same treatment. The PSB isolate III, AEZ-11 (T_4) revealed the maximum 1000-kernel weight (33.75 gm), seed yield per 10 plants (33.88 gm) and straw yield per 10 plants (54.99 gm), respectively. In respect of nutrient content, the seed and straw of barley showed the maximum amount of N (2.43 and 1.42%), P (0.69 and 0.51%), K (0.91 and 2.48%) content in the T_4 treatment. The better performing PSB isolate (PSB isolate III) increased the P availability in the soil than rest of the three isolates. The enormous amount of PSB population (3.0×10^5 per gm soil) was also produced in the T_4 treatment. The worst performance was recorded in the T_1 (Control) treatment in case of all parameters of barley production.