Studies on productivity of lowland rice (*Oryza sativa* L.) under different crop establishments Techniques and Nutrient Management Practices

Author: Badahunlang Wahlang
Submitted on: 17th May 2010

A field experiment was conducted during *kharif* season of 2008 at the Agronomy Research Farm of ICAR Research Complex for NEH Region Barapani, Meghalaya with the objectives (i) to work out the suitable crop establishment technique, and (ii) to study the effect of various nutrient management practices on the rice grown under different crop establishment techniques. The farm is situated at a latitude of 25° 41´ N and longitude of 91° 54´ E and an elevation of 950 m above the mean sea level. Treatment comprised of three crop establishment techniques viz. System of Rice Intensification (SRI), Integrated Crop Management (ICM) and Conventional Rice Culture (CRC) while 5 nutrient management practices viz. recommended NPK (80: 60: 40 N, P₂O₅, K₂O kg/ha), FYM 10 t/ha, 50% recommended NPK + FYM 10 t/ha, recommended NPK + FYM 5 t/ha and control were arranged in sub plots. The treatments were tested in Split Plot Design with three replications and Sahsarang-1 was used as a test variety. The experimental results revealed that SRI plants recorded higher growth and developmental parameters, viz. plant height, number of tillers, number of leaves, dry matter production and root growth. Similarly, all the yield attributing parameters, viz. panicle length, number of panicles per hill, number of grains per panicle, number of filled grains per panicle and test weight were higher with SRI establishment technique. However, the number of panicles/m² was higher with ICM establishment technique as compared to SRI. Maximum grain and straw yield being at par with SRI was recorded with ICM, and lowest was with CRC. Among the nutrient management practices, combined application of recommended NPK + FYM 5 t/ha recorded the highest value of all the growth and yield attributing parameters, followed by 50% recommended NPK + FYM 10 t/ha. Lowest value was observed with control. Highest NPK uptake, being at par with ICM was recorded with SRI. The lowest nutrient was recorded with CRC. NPK uptake was higher with combined application of inorganic fertilizer and organic manure and lowest was observed with control. The crop establishment techniques and nutrient management practices were found to influence residual nutrient status of soil. Available soil NPK was higher with application of recommended NPK and incorporation of FYM 5 t/ha. SRI technique of establishment recorded maximum available soil NPK status.

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School: Natural Resource Management  
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Performance of quality protein maize (zea mays l.) (qpm) varieties in response to nitrogen levels

Author: Badapmain Makdoh  
Submitted on: 24th October 2011

A field experiment was conducted at the upland Agronomy Research farm of the ICAR RC for NEH Region, Umiam during kharif of 2010 to study the response of Quality Protein Maize varieties at varying nitrogen levels. The experiment was laid out in Split plot design with three replications. Three varieties viz. HQPM 1, HQPM 2 and RCM 1-1 (check) and four nitrogen levels of 0, 50, 100, 150 kg ha⁻¹ were taken as main plot and sub-plot respectively with 12 treatment combinations. Nitrogen application significantly increased the grain yield up to highest level, but no significant difference was observed between the yield of 100 and 150 kg Nha⁻¹. Among varieties HQPM 2 produce maximum grain yield (6.14 t ha⁻¹). Plant height increases with increasing levels of N, whereas 100 and 150 kg Nha⁻¹ were at par with each other and the tallest plant was found in RCM1-1. However, maximum leaf area, LAI, chlorophyll content as well as dry matter production was obtained with HQPM 2 and all the parameters remained highest with 150 kg Nha⁻¹. Growth parameters like CGR and NAR were found to increase with N levels and more significantly at 30-60 days stage, whereas RGR shows decreasing rate with increase N levels. In general, the yield attributes viz. cob weight, cob length, cob girth, and kernels weight cob⁻¹, number of kernels cob⁻¹, number of rows cob⁻¹, test weight and shelling % were found to increase with the levels of N and associated with HQPM 2. Harvest index decreases with increasing N levels and the highest value was recorded in 37.6%. Days to 50% flowering as found to decrease with N levels and variety HQPM 2 takes more days to flower. NPK uptake increases as the N levels increases and the highest value recorded in HQPM 2. HQPM 1 and HQPM 2 significantly increases in grain protein content as the N levels increases and, whereas RCM 1-1 shows declining trend beyond 100 kg Nha⁻¹. The B: C ratio of the highest N level is the highest (1.99:1) and variety HQPM 1 and HQPM 2 were at par.

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Evaluation of soil measure conservation measures for enhancing crop water productivity in maize-based cropping systems

Author: Bidyapati Ngangom
Submitted on: 28th September 2013

A field experiment was conducted on “Evaluation of soil moisture conservation measures for enhancing crop water productivity in maize-based cropping systems” at the upland field of Agronomy, Section (950 m above mean sea level) ICAR Research Complex for NEH Region, Umiam, Meghalaya, during kharif and rabi season 2012. During kharif, a general crop of maize was grown uniformly under recommended package of practices. In rabi, after maize, the crops were grown under zero tillage with five cropping systems (CS) as main plot treatments viz, Maize-Fallow (CS1), Maize-Toria (CS2), Maize-French bean (bush type) (CS3), Maize-French bean (pole type) (CS4), Maize-Blackgram (CS5) and four soil moisture conservation (SMC) measures as sub plot treatments viz, no mulch (M0), in-situ maize stalk mulch (MSM) (M1), M1+Ambrosia sp. 10 t ha\(^{-1}\) (M2), M1+ Tephrossia sp. 10 t ha\(^{-1}\) (M3). Results from the experiment revealed that in-situ retention of maize stalk along with Tephrossia/Ambrosia mulch helped to conserve soil moisture and improved soil physico-chemical and biological properties. Zero tillage coupled with mulch substantially increased soil moisture content at different depths for rabi crops. The soil moisture content ranged from 14-33% under various treatments at different crop growth stages and depths. With the advancement of crop growth, soil moisture content decreased and lowest moisture was recorded at harvest. Among all the cropping systems, Maize-Blackgram system conserved more soil moisture followed by Maize-French bean (pole type) system. In-situ retention of maize stalk cover along with Tephrossia mulch conserved maximum soil moisture which was statistically similar to MSM+Ambrosia mulch. The infiltration rate was minimum in no mulch and higher infiltration rate was recorded under MSM+Tephrossia mulch. MSM+Tephrossia/Ambrosia mulch decreased soil bulk density and increased water holding capacity substantially. These treatments also resulted in higher soil organic carbon (SOC) and soil microbial biomass carbon (SMBC). Among the cropping systems, Maize-French bean (pole type) system recorded maximum SOC (1.72%) and SMBC (258.55 µg g\(^{-1}\) soil) at harvest. The N P and K uptake by seed and stover were higher under MSM+Tephrossia mulch in all the cropping systems. The leaf relative water content was found to be highest under MSM+Tephrossia mulch followed by MSM+Ambrosia mulch. Chlorophyll index (CI) was higher at 60 DAS in all the cropping systems except Maize-Toria cropping system which recorded higher CI at 30 DAS. Highest maize equivalent yield (MEY) was obtained from Maize-French bean (pole type) system under MSM+Tephrossia mulch (9.5 t ha\(^{-1}\)) followed by MSM+Ambrosia mulch (8.8 t ha\(^{-1}\)). Irrespective of cropping systems, maximum WUE was recorded under MSM+Tephrossia mulch (9.29 kg ha\(^{-1}\) mm\(^{-1}\)) which remained similar to MSM+Ambrosia mulch. The water productivity was highest in Maize-Toria system (0.31 kg m\(^{-3}\)) and it was higher under MSM+Tephrossia mulch in all the crops. The system productivity was highest in Maize-French bean (pole type) under MSM+Tephrossia mulch (49.76 kg ha\(^{-1}\) day\(^{-1}\)). The net return (Rs. 95268 ha\(^{-1}\)) and B: C ratio (2.58) was maximum in Maize-French bean (pole type) system. The energy
output was maximum in Maize-Toria system whereas net energy, energy use efficiency and energy productivity were maximum in Maize-Blackgram system. It was concluded that Maize-French bean (pole type) cropping system with MSM+ *Tephrosia/Ambrosia* mulch in French bean is a profitable option with higher productivity in mid altitude of Meghalaya.

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A research experiment was conducted during 2011 at College Research Farm of the College of Post Graduate Studies, Central Agriculture University, Barapani, Meghalaya. The experiment was undertaken to evaluate the effects of fertility levels on different method of planting on potato (*Solanum tuberosum*) intercropped with maize (*Zea mays*) on its yield, yield advantage, competitive performance and their economics. Significantly higher growth, yield attributes and finally yield of potato and maize obtained in sole cropping system in ridge and furrow and paired ridge row method, respectively. The LER (1.47) and AHER (0.73) values were greater for the potato + maize in 1:1 ratio in the systems, there was an advantage of intercropping for exploiting the resources of the environment. The highest value of LEC (0.47), ATER (1.19), RCC (9.84) and MAI (60578.29) were obtained in 1:1 potato + maize intercropping in the system. However the aggressivity of potato + maize was highest in 2:2 potato + maize intercropping. All the partial value such as LER, LEC, AHER and intercropping advantage were greater for potato than for maize in 1:1 ratio of intercropping, whereas the corresponding values for maize were lower in mixtures with potato. The intercropping competitive parameters like aggressivity were higher in the intercropping with the 2:2 ratios. These findings indicate that potato was more competitive partner than maize as maize was affected more in mixtures with 2:2 ratios. Residual fertility status of soil was significantly higher in 1:1 ratio with paired ridge row method of planting. However, all the yield advantage and competitive parameters decrease with increase in fertility level of the planting method but the yield loss of both the crops were compensated by the inter crops. Highest economic and intercropping advantage parameters (B:C ratio, LER, LEC) were observed in 1:1 ratio with ridge and furrow methods. The results indicate that potato + maize intercropping in 1:1 ratio on ridge and furrow method provide highest net profit over the other intercropping ratio in different planting method.

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       (ii) Rajesh Kumar, Senior Scientist, ICAR – RC for NEH Region
       (iii) A.K Singh, Assistant Professor, Agronomy, CPGS, CAU
A field experiment was conducted at the Water Management field, ICAR Research Complex for NEH Region, Umiam, during 2009-10 on “Assessment of Water Efficient Cropping Systems for Rainfed Terraced Situation of Meghalaya”. The experiment consisted of two tillage practices as main plots treatments- conventional tillage (CT) and conservation tillage (CST), and eight cropping sequences (4 cropping systems) as sub plot treatments (CS), viz, Maize-Toria (CS1), Maize-Pea (CS2), Rice -Toria (CS3), Rice-Pea (CS4), Ricebean-Toria (CS5), Ricebean-Pea (CS6), Soybean-Toria (CS7) and Soybean-Pea (CS8). The results indicated that conservation tillage recorded significantly higher profile soil moisture content, relative leaf water content, nutrient uptake and water use efficiency (WUE) as compared to conventional tillage. Soil organic carbon (SOC), available NPK, dehydrogenase activity and soil microbial biomass carbon were significantly higher in CST as compared to CT. Overall productivity of crops under CST in terms of grain yield were 25% and 27% higher, while in term of maize equivalent yield, they were 24% and 27% higher as compared to CT for kharif and rabi crops, respectively. The net return and B:C ratio were also higher under CST as compared to CT.

At harvest of kharif crops, soil profile moisture was highest under soybean. At sowing of rabi crops, pea and toria succeeded maize recorded the highest soil moisture under conservation tillage. Soil profile moisture had never depleted below 50% of the soil moisture at field capacity under conservation tillage in all cropping sequences involving toria except ricebean-toria. Among kharif crops, N, P and K uptake were maximum in soybean, maize and rice, respectively. While for rabi crops, maximum N and K uptake was recorded in pea of rice-pea sequence and maximum P uptake in toria of maize-toria. Highest WUE was recorded in maize-toria sequence (23.9 kg ha^{-1}mm^{-1}) followed by maize-pea (19.9 kg ha^{-1}mm^{-1}). The SOC, soil available N, SMBC, and DHA were highest in soybean-pea sequence. The system productivity in term of MEY was highest in soybean-pea sequence (7.14 t ha^{-1}) followed by rice-pea (6.4 t ha^{-1}). Soybean-pea sequence recorded highest net return and B:C ratio of 2.9 and 2.4 in CST and CT, respectively. Therefore, from WUE and soil moisture utilization point of view, maize-toria sequence found to be most efficient. Whereas, considering soil health and income soybean-pea sequence was found most efficient.

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Incidence of residue management of rice cultivars on soil health and productivity of succeeding lentil (Lens esculentus)

Author: Emdor Shylla  
Submitted On: 1st July 2014

Rice based cropping system is the pre-dominant cropping system of North East India including Meghalaya. In Meghalaya after rice harvest the land mostly remain fallow due to extreme moisture deficit in upland and excess moisture in lowland owing to seepage from surrounding hillocks. There is a very good potential for cultivation of lentil after rice in lowland if appropriate resource conservation measures are adopted. Keeping this in mind, a field experimentation was conducted on “Influence of residue management of rice cultivar on soil health and productivity of lentil” in lowland rice fallow in mid altitude of Meghalaya with the objectives to identify suitable rice and lentil cultivars and appropriate residue management practices for enhancing productivity of rice-lentil system. Two rice cultivars, Shahsarang 1 (medium duration, HYV) and Mendri (long duration, local variety) were grown during the kharif season followed by two lentil cultivars i.e. DPI 81 and IPL 406 grown under three rice stubble management practices during the rabi season. The experiment was laid out in a double split design with two main plots (rice cultivars), two sub plots (lentil cultivars) and three rice stubble management practices (20 cm standing stubble, mulching and residue removal). The results revealed that there was no significant effect of rice cultivars on performance of lentil. However, the lentil yield was significantly influenced by lentil cultivars. IPL 406 recorded significantly higher yield (1.82 t ha\(^{-1}\)), WUE (9.46 kg ha\(^{-1}\) mm\(^{-1}\)) and WP (3.30 kg m\(^{-1}\)) compared to DPL 81. Among rice stubble management practices, mulching recorded significantly higher lentil yield (1.87 t ha\(^{-1}\)), WUE (9.75 kg ha\(^{-1}\) mm\(^{-1}\)) and WP (3.40 kg m\(^{-1}\)) compared to 20 cm SS and removal. Irrespective of rice and lentil cultivars, mulching recorded about 20.6% higher lentil yield compared to residue removal and 20 cm SS. Available N and K were higher under DPL 81 grown after Shahsarang 1 as compared to Mendri. Significantly higher available N, K and SOC was recorded under mulching compared to 20 cm standing stubble (SS) and removal. The soil resistance increased with soil depth and minimum resistance was recorded under mulching followed by 20 cm SS. Bulk density was lower under IPL 406 grown after Shahsarang 1 with the lowest BD recorded under mulching. The MWD and porosity was higher when lentil cultivars were grown after Mendri undermulching compared to 20 cm SS and removal. The soil moisture content and stock throughout the cropping season was recorded highest under mulching followed by 20 cm SS. The dehydrogenase activity (DHA) and soil microbial biomass carbon (SMBC) were significantly higher under mulching compared to removal and 20 cm SS. Higher net return and B:C ratio was recorded in IPL 406 after Shahsarrang 1 and significantly highest return was recorded under mulching (86,049 ha\(^{-1}\)) with a B:C ratio of 1.67 compared to residue removal (61,158 ha\(^{-1}\), 1.19). Thus growing of lentil (IPL 406) under mulching after HYV rice (Shahsarang 1) is a recommendable option for higher productivity, WUE, soil health and income.

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School: Natural Resource Management  
Discipline: Agronomy

Effects of in-situ residue management on carry over soil moisture conservation practices and growth and productivity of mustard (*Brassica campestris*) in mid-hill altitude.

Author: Enboklang Khrakrang  
Submitted on: 22\textsuperscript{nd} September 2009

The field experiment was conducted at the Water Management field, ICAR Research Complex for NEH Region, Umiam during the year 2008-09 to study the effect of in-situ residue management on carry over soil moisture conservation practices and growth and productivity of mustard (*Brassica campestris*) in mid-hill altitude. The experiment was laid out in Split Plot design with two main plot treatments, six sub-plot treatments and replicated thrice. The main plot treatments were conventional tillage and zero tillage. The sub-plot treatments consisted of different combinations of mulching materials, comprising maize stalk, *Ambrosia* weed biomass, FYM and poultry manure, which are tried for their moisture conservation abilities. In general, the soil moisture was higher under zero tillage than conventional tillage. Zero tillage also increased the soil temperature and soil organic carbon (OC). Adoption of FYM @10 t/ha + maize stalk cover (MSC) poultry manure @5t/ha + *Ambrosia* @5 t/ha + MSC or *Ambrosia* @10 t/ha +MSC proved to be more efficient than other organic materials, regardless of the tillage. Further, all the mulching treatment improved the soil physical properties and resulted in much better yield than the control. The Bulk densities of surface (0-15 cm) soils during the growing season of both maize and mustard crops were significantly affected by different conservation measures. In general, available Nitrogen (N) and potassium (K) was found to be higher in the conventional tillage plots, but the amount of available phosphorous was higher in the zero tillage system. In terms of yield, the mulching practices (maize stalk with or without *Ambrosia*) performed better and produced 1.5 to 4.5 times higher yield than the control. The improvement in the crop performance was evident from the difference of the treated plots, when compared with the control, where the lack of moisture caused lower growth, branching and pod formation leading to lower biomass and relative turgidity. Taking the economics of cultivation into consideration, *Ambrosia* @ 10t/ha was found to be superior to all the other treatments, for both the tillage system.

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School: Natural Resource Management
Discipline: Agronomy

Performance of toria (Brassica campestris L.var.toria) on raised beds in marshy areas of Meghalaya

Author: Haradev Brahma
Submitted on: 17th August 2011

A field experiment was conducted during rabi season of 2009 at the Agronomy Research Farm (Marshy land) of ICAR Research Complex for NEH Region, Barapani, Meghalaya with the objectives (i) to study the soil moisture and nutrient dynamics on different bed heights (ii) to study the crop performance and nutrient uptake at different bed heights and (iii) to study the effect of Farm Yard Manure (FYM) on growth and yield of toria. The farm is situated at latitude of \(25^041'\) N and longitude of \(91^054'\) E and an elevation of 950 m above the mean sea level. Treatment comprised of two levels of FYM viz., No FYM and FYM @ 5 t/ha as the main treatments and four raised bed heights of 20 cm, 30 cm, 40 cm and 50 cm were arranged in sub-plots. The treatments were tested in Split Plot Design with three replications and the variety used was M-27, an improved and high yielding variety with high oil percentage. The experimental results revealed that plants with application of FYM @ 5 t/ha recorded higher plant growth parameters viz., plant height, number of leaves per plant, number of branches per plant and plant dry matter (g/plant). Days to bolting and flowering were also found to be earlier with FYM treatment. Similarly, all the yield attributing parameters viz., no of siliqua per plant, siliqua length, seeds per siliqua, seed weight/plant, 1000 seed weight, seed yield, straw yield, biological yield, Harvest Index, water use efficiency and soil profile water use efficiency were higher with application of FYM @ 5 t/ha. NPK content and uptake was found to be higher with application of FYM and lowest was recorded with no FYM. Profile soil moisture content and saturated hydraulic conductivity was higher with FYM treatment. Application of FYM @ 5 t/ha recorded higher available nutrient status in the soil.Among the different raised bed heights, 40 cm and 50 cm beds recorded higher growth attributes like plant height, number of leaves, number of branches and plant dry matter. Days to bolting and flowering were earlier on 50 cm bed although differences among bed heights were non significant. Yield attributing parameters like siliqua per plant, siliqua length, seeds per siliqua, seed weight per plant, seed yield, straw yield, biological yield and water use efficiency including soil profile water use efficiency were higher on raised beds of 40 cm and 50 cm followed by 30 cm and 20 cm beds. Saturated hydraulic conductivity was higher on bed heights of 40 cm and 50 cm. Soil moisture content increased with the decrease in bed height and along the soil profile, with highest moisture recorded on 20 cm bed height. Available soil N and K and organic carbon content was higher on 50 cm and 40 cm bed heights.

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(iii) P.K Bora, Associate Professor, Soil and Water Conservation, CPGS, CAU.
Field experiments were conducted during summer and kharif seasons, 2012 at Research Farm of CPGS, CAU, Umaim, Meghalaya. The summer experiment was laid out in split plot design with 2 levels of green manuring (G1 and G2; rice bean as green manure) and 3 levels of phosphorus (P0, P30 and P60) allocated in main and sub plot, respectively. The kharif experiment was arranged in double split plot by splitting the sub plot to sub-sub plot for allocation of 3 levels of intercropping system (I1, I2 and I3). The treatments were replicated four times. The growth parameter, yield attributes and yield increased significantly with green manuring and P levels. The highest value of plant height, leaf area index, dry matter accumulation, no. of baby cob, weight of baby cob, cob:husk ratio, baby cob and fodder yield were obtained with green manuring and 60 kg P 2O5 ha⁻¹ in both the seasons. The crop growth rate (CGR) was influenced significantly at 30-60 DAS stage by green manure. Whereas, P-levels significantly influenced the CGR at 30-60 DAS and 60 DAS-at harvest stage during both the seasons with exception at 30-60 DAS during second season. However, significantly higher values of net assimilation rate (NAR) were observed with green manuring and P levels during kharif and summer season, respectively. Whereas, relative growth rate (RGR) produced significant results with P (30-60 DAS) and green manuring (30-60 DAS and 60-harvest stage) in summer season and kharif season, respectively. The above growth and physiological parameters of groundnut followed the similar trend, but the physiological parameters did not vary significantly with green manuring. Nitrogen (N), P and protein content in baby corn and groundnut were significantly influenced by green manuring and P levels and the highest values recorded at green manure with 60 kg P 2O5 ha⁻¹ during both seasons. In intercropping system all the growth, physiological parameters, yield attributes and quality parameters of baby corn were significantly higher than the sole crop, however, these parameters for groundnut were more in sole crop, except the quality parameter and plant height. Green manuring significantly influenced organic carbon (OC), N, P in soil after harvest during both the seasons, while P levels had significant impact on residual P (both seasons) and OC (summer season). Green manuring and P levels had significant influence on all soil biological parameters in both the seasons with an exception of soil microbial biomass-carbon and -nitrogen due to P in kharif season. Growing of baby corn and groundnut in association caused significant improvement in residual fertility status of the soil, however, the association fails to improve pH and OC. Land equivalent ratio, area time equivalent ratio and monetary advantage index are parameters which indicate the efficiency of intercropping and the highest values of all parameters were associated with 60 kg P 2O5 ha⁻¹ and intercropping system of babycorn + groundnut. Among competition indices the groundnut was more aggressive and shows its dominance over baby corn as it grown up to full maturity stage. Maximum B: C ratio of 2.75 and 2.87 were obtained with 60 kg P2O5 ha⁻¹ in summer and kharif season, respectively. Whereas, the highest B: C ratio of 2.69 and 3.25 were obtain with green manuring and intercropping during
It can be concluded that baby corn can successfully be grown with green manuring and 60 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> in summer season and the second crop of baby corn with residual fertility in association of groundnut during kharif season.

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Effect of integrated nutrient management practices on productivity and quality of baby corn

Author: Jenny Moyong
Submitted on: 22nd October 2011

A field experiment entitled “Effect of integrated nutrient management practices on productivity and quality of baby corn” was conducted at Research farm of CPGS,CAU, Umiam, Meghalaya during kharif season of 2010 to study the effect of Integrated Nutrient Management Practices on productivity and Quality of baby corn. The experiment was laid out in Split Plot design with three replications with nine treatment combinations, consisting of three nutrient source combination viz., 80, 60, 40 kg NPK through chemical fertilizer, 15 t FYM and 40, 30, 20 kg NPK through chemical fertilizer +7.5 t FYM along with three biofertilizer treatments viz., control (Bo), Azospirillum (B1), PSB (B2), Application of FYM, fertilizer and seed inoculation with biofertilizer was done as per treatments. The soil of experimental site was sandy clay loam in texture, moderately acidic in reaction (pH: 5.3), medium in available nitrogen and organic carbon but low in available phosphorus and potassium. Combined application of nutrient source 40, 30, 20 kg NPK through chemical fertilizer +7.5 t FYM shows higher growth attributes, yield attributes and yield. Highest baby corn yield (7.63 t ha⁻¹) was obtained with treatment 80, 60, 40 kg NPK through chemical fertilizer +7.5 t FYM which was at par with 15 t FYM (7.24 t ha⁻¹). The biofertilizer treatments were found to bring about significant differences on yield of baby corn. The highest cob yield of 7.42 t ha⁻¹ was obtained with the application of PSB however was found to be at par with the Azospirillum treatment with the yield of 7.23 t ha⁻¹. The lowest yield was obtained without biofertilizer treatment of 6.71 t ha⁻¹. Maximum plant height, leaf area, leaf area index was also obtained with application of 80, 60, 40 kg NPK through chemical fertilizer +7.5 t FYM associated with PSB inoculation. Other growth parameters like CGR also increased with 80, 60, 40 kg NPK through chemical fertilizer +7.5 t FYM more significantly at 60 to harvest stage. Yield attributes like baby corn weight, number of cob per plant was also higher with 80, 60, 40 kg NPK through chemical fertilizer +7.5 t FYM but was at par with 15 t FYM. Protein content in baby cob vary with treatment and maximum value of 14.04% was obtained with 40, 30, 20 kg NPK through chemical fertilizer +7.5 t FYM along with PSB. However higher ascorbic acid content was obtained with 15 t FYM with PSB combination. Application of 40, 30 and 20 kg NPK through chemical fertilizer + 7.5 t FYM along with PSB in baby corn improves the fertility status of soil. Higher SMBC, DHA, available NPK also observed with 40, 30 and 20 kg NPK through chemical fertilizer + 7.5 t FYM with PSB treatment. Highest net return and B: C (3.80) ratio was however observed with treatment 80, 60,40 kg NPK through chemical fertilizer and among biofertilizer treatment maximum B: C ratio of 2.56 was observed with PSB.
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Soil acidity and ensuing phosphorus (P) deficiency are the major constraints to crop production in acidic soils. Lime and P application is recommended to overcome these limitations. However, given the widely perceived negative interactions of lime and P with Zn, they could be expected to reduce the availability, uptake and translocation of zinc (Zn) in plant, with its obvious implications for grain nutritional qualities and human health. Field and pot experiments were therefore conducted to test the hypothesis whether lime and P application adversely affects Zn nutrition of maize, and if so, whether Zn application can mitigate the negative interaction of lime and P with Zn, increasing thereby the yield and nutritional qualities of maize on acidic soil of Meghalaya. The treatment consisted of three levels of lime (L₀ – no lime, L₀.₅ – furrow application @ 500 kg ha⁻¹ and L₃.₀ – broadcasting @ 25% lime requirement i.e. @ 3 t ha⁻¹), two levels of P (P₀ – no P and P₆₀ – 60 kg P₂O₅ ha⁻¹) and two levels of Zn (Zn₀ – no Zn and Zn₅ – 5 kg Zn ha⁻¹) in factorial combination, with each treatment replicated thrice. In general, growth and yield parameters responded positively to lime, P and Zn application. Grain yield was significantly improved with L₀.₅ (19%) and Zn₅ (42%) application, with yield gain due to P addition being non-significant. At any level of lime and P addition, Zn application improved grain yield, with the best response (6.44 t ha⁻¹) being obtained when Zn was applied along with lime (furrow applied @ 0.5 t ha⁻¹) and recommended dose of P. Contrary to the beneficial effects of lime and P fertilization on grain yield, they tended to reduce the Zn concentration and increase the P/Zn ratio (signifying lower Zn bioavailability) in maize grains, indicating the reduction in nutritional qualities. However, such deterioration in nutritional qualities was reverted by Zn application by virtue of increased Zn content and reduced P/Zn ratio. While lime and P application increased soil pH and P availability, Zn availability remained unaffected, which was increased significantly (39%) by Zn application. This observation rules out the possibility of negative interaction of Zn with lime and P in soil, which was apparent mostly in plant. Results of pot experiment were by and large consistent with those of field experiment. Benefit/Cost ratio was also significantly increased (18%) by liming (furrow application @ 500 kg ha⁻¹) and Zn application (33%). On the whole, while application of lime and P increased the grain yield, they tended to reduce the concentration and bioavailability of Zn in maize grains. However, inclusion of Zn along with recommended dose of lime and P could successfully revert the trend. Moreover, the yield benefit from Zn application was higher than that from lime and P application. Thus, application of Zn @ 5 kg ha⁻¹ along with recommended dose of lime (furrow application @ 500 kg ha⁻¹) and P (60 kg P₂O₅ ha⁻¹) can be recommended for improving the yield and nutritional qualities of maize as well as farm income in acidic soils of the region.
Advisory Committee

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Members: (i) Manoj Kumar, Scientist (Soil Science), Division of Natural Resource Management, ICAR-RC for NEH Region.
(ii) Vishram Ram, Associate Professor, Farming System, CPGS, CAU.
(iii) Jayanta Layek, Scientist (Agronomy), Division of Natural Resource Management, ICAR-RC for NEH Region.
Influence of land configuration and residue management on productivity of rainfed groundnut (Arachis hypogaea) - toria (Brassica campestris var. Toria) cropping system

Author: Kevizhalhou Kuotsu
Submitted on: 03 Sept 2011

Soil erosion, erratic rainfall and moisture stress are the major problems for crop Production and sustainable land management in hilly regions. This experiment was conducted to study the influence of land configuration and residue management on productivity of rainfed groundnut (Arachis hypogaea L.) - toria (Brassica campestris var. toria) cropping system on a hilly terrain at an altitude of 950 m from mean sea level during the year 2010-2011. The experiment was carried out on a terraced land in randomized block design with seven treatments replicated thrice. The treatments were: (i) flat bed, no residue; (ii) broad beds and furrows (BBF) with residue incorporation; (iii) BBF with residue + hedge leaves (Tephrosia sp) incorporation; (iv) BBF with residue + hedge leaves (no tillage, NT); (v) raised bed (RB) with residue incorporation; (vi) RB with residue + hedge leaves incorporation; (vii) RB with residue + hedge leaves (NT). Periodical observations were taken for various parameters. Soil profile moisture was found to be higher in the plots where residues were present under altered land configuration and they retained higher moisture even during post monsoon as compared to the farmer’s practice. Soil organic carbon, pH and bulk density were not affected significantly by the treatments. Infiltration rate and hydraulic conductivity was highest under RB with residue + hedge leaves (NT). Soil microbial biomass carbon and dehydrogenase activity recorded a maximum of 276μg/g soil and 48.9 μg TPF/g soil/24hr in RB with residue + hedge leaves incorporation and RB with residue incorporation respectively. Weed infestation was higher in the NT treatments. Yield in terms of groundnut equivalent yield was highest in RB with residue + hedge leaves (No tillage) (2,988 kg/ha) followed by RB with residue incorporation (2,953 kg/ha) while the minimum was in BBF with residue + hedge leaves (No tillage) (2,163 kg/ha). A similar trend was also observed in the production efficiency. Water use efficiency in the case of toria was found maximum in RB with residue + hedge leaves incorporation (4.64 kg/ha-mm) and the minimum in farmer’s practice (1.49 kg/ha-mm). Over all, RB with residue + hedge leaves (NT) showed the highest B:C ratio of 1.67 followed by BBF with residue + hedge leaves (NT) with 1.4 while the minimum was in RB with residue + hedge leaves incorporation with 1.28. The effect of land configuration and residue management on crop productivity was not found to be significantly affected during monsoon. However the effect was profound during post-monsoon with the conservation treatments giving better results than the farmer’s practice where no residues were incorporated or retained. Treatments under raised beds were however found to be more profitable and sustainable as compared to the other treatments.
Advisory Committee
Chairman: (i) G.C Munda, Principal Scientist, Division of Agronomy, ICAR – RC for NEH Region.
Members: (i) Anup Das, Senior Scientist, Division of Agronomy, ICAR – RC for NEH Region.
(ii) B.C Verma, Scientist, Division of Soil Science, ICAR – RC for NEH Region.
(iii) Lala I.P Ray, Assistant Professor, Water Resource Management, CPGS, CAU.
Evaluation of rice cultivation under various planting geometry in mid altitude lowland condition of Meghalaya

Author: Khwaipakram Lenin Singh
Submitted on: 13th September 2013

A field experiment entitled “Evaluation of rice cultivars under various planting geometry in mid-altitude lowland condition of Meghalaya” was conducted during Kharif 2012 at Research Farm of College of Post Graduate Studies, Central Agriculture University, Umiam, Meghalaya to find out high yielding rice cultivars with suitable planting geometry. The treatments consisted of three rice cultivars and four planting geometry with 12 treatment combination and was laid out in randomized block design. Experimental result shown that cultivars had significant effect on panicle per hill, panicle length, test weight, grain yield per hill. The maximum grain yield (5.72 t ha\(^{-1}\)) was recorded from hybrid cultivar Arize 6444 which was statistically superior over other two cultivars at all the planting geometry. Planting geometry also significantly influenced all the growth parameter and yield attributes except plant height, chlorophyll content, 50% maturity, and total grain per panicle. Maximum value of panicle per hill, grains per hill, test weight and grain yield per hill was obtained from 20 cm x 25 cm planting geometry. Maximum grain yield (5.07 t ha\(^{-1}\)) from Arize 6444 and Shahsarang1 was recorded from 20 cm x 20 cm planting geometry while Mynri produced the same at 20 cm x 10 cm planting geometry. Total uptake of N, P and K was also varied significantly due to cultivars and planting geometry except for total K due to cultivars. Highest uptake of N, P and K was recorded from Arize 6444 which was significantly more over other two cultivars. Uptake of N, P and K was statistically at par among 20 cm x 10 cm, 20 cm x 15 cm and 20 cm x 20 cm but significantly superior over 20 cm x 25 cm planting geometry. Highest net return (\$48,633) and B:C ratio (1.94) was reported from Arize 6444 at 20 cm x 20 cm planting geometry followed by same cultivar (\$36,689 and 1.69) at 20 cm x 15 cm planting geometry. Shahsarang1 and Mynri gave maximum net return (\$29,538 and \$25,536) and B:C ratio (1.60 and 1.50) at the planting geometry of 20 cm x 20 cm and 20 cm x 10 cm, respectively.

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         (ii) Lala I.P Ray, Assistant Professor, Water Resource Management, CPGS, CAU.
         (iii) N. Janaki Singh, Assistant Professor, Soil Science, CPGS, CAU.
Influence of phosphorus levels and bioinoculants on growth, spectral reflectance, and yield of rice

Author: Raghuveer M
Submitted on: 27th July 2013

A field experiment was conducted during 2012 (kharif season) at College Research Farm of the College of Post Graduate Studies, Central Agricultural University, Barapani, Meghalaya. The experiment was undertaken with split plot design replicated thrice to evaluate the influence of phosphorus (P) levels and PSB strains on agro-physiology, spectral reflectance and yield of rice (Oryza sativa L.) under acid soil. Application of 60 kg P$_2$O$_5$ ha$^{-1}$ and Pseudomonas sp. inoculation produced significantly maximum value of agro-physiological parameters (plant height, leaf area index, dry matter accumulation, CGR, RGR, NAR, root volume and root biomass, etc.) and yield attributes. Similarly, highest yield was obtained with 60 kg P$_2$O$_5$ ha$^{-1}$, but PSB strains did not able to produce the yield upto significance level. Spectral indices i.e normalized differential vegetation index in the hyper spectral region (NDVIh) and chlorophyll index (CItg) were found significantly higher in 60 kg P$_2$O$_5$ ha$^{-1}$ at early growth stages, but at final stage it was higher in control, whereas PSB strains did not bring any significant variation in spectral indices at all growth stages of the crop. P and K content in grain and straw were highest with 60 kg P$_2$O$_5$ ha$^{-1}$ and Pseudomonas sp. Though, N, P and K uptake were significantly affected only by P levels and highest values were achieved with 60 kg P$_2$O$_5$ ha$^{-1}$. The simple and interaction effect of phosphorus and PSB strains were significant on availability of P and highest value of residual P was observed when 60 kg P$_2$O$_5$ ha$^{-1}$ associated with Pseudomonas sp. The soil microbial and enzymatic activities were found significantly higher in 60 kg P$_2$O$_5$ ha$^{-1}$ with Pseudomonas sp. Maximum net return and B:C ratio of Rs. 12467.97 and 1.28 were obtained with 60 kg P$_2$O$_5$ ha$^{-1}$, respectively. However, economics were not influenced significantly with PSB strains. Finally application of 60 kg P$_2$O$_5$ ha$^{-1}$ with Pseudomonas sp. recorded the highest productivity and profitability.

Advisory Committee

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(ii) Rajesh Kumar, Senior Scientist, Division of Agronomy, ICAR – RC for NEH Region.
(iii) Lala I.P Ray, Assistant Professor, Water Management, CPGS, CAU.
A field experiment was conducted at the upland Agronomy Research farm of the ICAR RC for NEH Region, Umiam during kharif of 2010 to study “Weed management in maize (Zea mays L.) through legume intercropping.” The experiment was carried out in a Factorial Randomized Block Design with twelve treatments replicated thrice. The treatments were (i) sole maize (ii) maize + groundnut (iii) maize + soybean (iv) control (no weeding) (v) one hand weeding (vi) two hand weeding (vii) mechanical method. Periodical observations were taken for various parameters. Among the intercropping situations maize + groundnut produced highest grain yield (63.86 q ha\(^{-1}\)) and among the weed management it was found with two hand weeding (67.67 q ha\(^{-1}\)). Maize height and dry matter production was found to be significantly increased in maize + soybean intercropping and with two hand weeding. In general, the yield attributes of maize viz., cobs number plant\(^{-1}\), cobs weight plant\(^{-1}\), cobs length was found to be significantly superior with maize + groundnut intercropping system and associated with two hand weeding. Intercrops grain yield was also found to be significantly increased due to intercropping and was associated with two hand weeding. Harvest index (HI) of maize was not affected by intercropping as compared to the HI of intercrops, but weed management significantly increased the HI of maize but not the HI of intercrops. Highest MEY was achieved with maize + soybean and with two hand weeding. LER was found to be highest in maize + soybean. Total N, P and K uptake in maize was found in maize + soybean, sole maize and maize + soybean intercropping system respectively. Among the weed management methods two hand weeding produced maximum total N, P and K uptake in maize. Sole maize recorded highest weeds dry weight along with control treatment (no weeding). Similarly, highest weeds density was found with sole maize in the control plots. In the experimental field broadleaf weeds such as, Borreria hispidia (L.), Amaranthus Ageratum conyzoides (L.), Commelina viridis (L.), Ambrosia artemisiifolia (L.), benghalensis (L.), Galinsoga parviflora Cav, Alternanthera philoxeroides (L.), Bidens pilosa (L.), Chromalaena odorata (L.) sedges and grasses such as Cyperus rotundus (L.), Cynodon dactylon (L.), Digitaria sanguinalis (L.), Eleusine indica (L.) were observed. WME was found to be higher with maize + soybean at harvest of maize whereas two hand weeding significantly increased the WME at 20 DAS, 40 DAS and at harvest of crop. Maize + soybean show maximum net return and highest B:C ratio among the intercropping situations whereas two hand weeding gave the highest net return among the weed management and highest B:C ratio was recorded in mechanical weeding.
**Advisory Committee**

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(ii) K.P Mohapatra, Sr. Scientist, Division of Agro-forestry, ICAR – RC for NEH Region.
(iii) B.U Choudhury, Sr. Scientist, Division of Soil Science, ICAR – RC for NEH Region.
Performance of quality protein maize under integrated nutrient management practices

Author: Samborlang K. Wanniang
Submitted on: 01 January 2012

A field experiment entitled “Performance of Quality Protein Maize under integrated nutrient management practices” was conducted during kharif 2011 on Experimental Farm of the College of Post Graduate Studies, Central Agriculture University, Barapani, Meghalaya to evaluate the effect of in-situ inter cropped cowpea green manuring and combined application of fertilizer with FYM on productivity, profitability and nutrient uptake of quality protein maize and their residual effects on soil fertility. Green manure maize recorded higher growth (plant height, leaf area and dry matter accumulation per plant), yield attributes, yield and nutrient uptake over sole maize though the difference for most of the parameters between them was statistically at par. Grain yield obtained in green manured maize (53.92 q ha\(^{-1}\)) was 22 per cent higher as compared to sole maize (44.21 q ha\(^{-1}\)). Among the various combinations of Recommended Dose of Fertilizer (RDF) with FYM, maximum yield (56.37 q ha\(^{-1}\)) was recorded from the treatment 75 % RDF + 5 t FYM ha\(^{-1}\) which was at par with the treatments 50 % RDF + 7.5 t FYM ha\(^{-1}\) (54.99 q ha\(^{-1}\)), 100 % RDF (53.62 q ha\(^{-1}\)) and 75 % RDF + 2.5 t FYM ha\(^{-1}\) (48.25 q ha\(^{-1}\)) but significantly superior over 50 % RDF + 7.5 t FYM ha\(^{-1}\) (45.33 q ha\(^{-1}\)) and control (35.83 q ha\(^{-1}\)). The nutrient addition through cowpea was the influential factor for the uptake of nutrients by grain, Stover and total uptake by maize plant. Highest economic return (\(^{\text{\textcurrency}}\) 30,300 ha\(^{-1}\)) was recorded from the treatment 75 % RDF + 5 t FYM ha\(^{-1}\) however; maximum benefit cost ratio (1.99) was obtained from the treatment RDF. Thus, treatment 75 % RDF + 5 t FYM ha\(^{-1}\) was proved as the best combination of fertilizers and FYM.

Advisory Committee:
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Members: (i) A.S Panwar, Principal Scientist, Division of Agronomy, ICAR – RC for NEH Region.
(ii) Vishram Ram, Associate Professor, Farming System, CPGS, CAU
(iii) Dwipendra Thakuria, Associate Professor, Soil Microbiology, CPGS, CAU
A field experiment entitled “Effect of sources and levels of nitrogen on performance of sweet corn (Zea mays var. Saccharata) on mid hills of Meghalaya” was conducted at Experimental Farm of the College of Post Graduate Studies (CAU), Umiam, (Meghalaya) during kharif 2012 to find out an appropriate nitrogen (N) dose for sweet corn and comparative evaluation of organic N sources with the dominant N fertilizer urea. The experiment was conducted with four sources of N (urea, FYM, compost and poultry manure) and four levels of nitrogen (0, 40, 80 and 120 kg N ha⁻¹) having 13 treatments. The experiment was laid out in randomized block design with three replications. The growth attended by sweet corn was measured as plant height, leaf area per hill, leaf area index, accumulation of dry weight per plant and crop growth rate. Both the sources and levels of N brought a significant difference in growth parameters. Each successive increase in nitrogen level resulted in a linear increase in growth parameters and highest value of them was recorded at 120 kg N ha⁻¹ which was significantly superior to 80 kg N ha⁻¹ however, the difference between 80 kg N ha⁻¹ and 120 kg N ha⁻¹ was non significant in some cases. Phenotypical crop development was studied as number of days taken to attain 50% of tasselling, silking and harvestable stage did not differed significantly due to sources of nitrogen however, nitrogen fertilized treatment took significantly more number of days for attaining these stage over non fertilized plants. Yield attributes measured as plant population at harvest, number of cobs per plant, cob length, numbers of grains row per cob, number of grains per grain row, number of grains per cob, test weight and cob weight per plant. Except plant population, cobs per plant and test weight, all the yield attributes varied significantly due to variation in sources and maximum value was observed with poultry manure N source while compost source of N produced their significantly lower values. However, all the yield attributes differ significantly due to variation in nitrogen levels and N fertilized treatments recorded significantly greater yield attributes over non N fertilized treatment. There was an increasing trend in all the studied yield attributes and significantly highest value were noticed at 120 kg N ha⁻¹. Cob yield, stover yield and biological yield (t ha⁻¹) differed significantly both due to sources and levels of nitrogen. Highest fresh cob yield was recorded from the poultry manure treatment which was 3.5, 8.6 and 20% higher over FYM, Urea and Compost, respectively. Biological yield also followed the same trend. N, P and K uptake through grain and stover of sweet corn and their total uptake as well differed significantly due to sources of nitrogen where highest uptake of all these three nutrients was recorded from poultry manure which was significantly superior to compost treatment. Significantly highest uptake of nutrient was recorded at 120 kg N ha⁻¹ which was significantly higher over all other nitrogen levels. Both the sources and levels of nitrogen sources brought a significant difference in chemical properties of soil measured as organic carbon content, availability of N, P and K after crop harvest. Highest net return was obtained from poultry manure while B:C ratio from urea N
supplied treatment. Among nitrogen levels, maximum net return and B:C ratio was observed from the highest N level of 120 kg ha$^{-1}$ which was significantly superior over all other nitrogen levels. The finding of the experiment revealed that maximum economic return from sweet corn could be obtained by applying 120 kg ha$^{-1}$ of N from poultry manure or FYM. Further, organic sources of nitrogen (poultry manure and FYM) were at par with urea for producing cob yield and net return besides leaving marked positive effect on important chemical properties of soil.

**Advisory Committee:**
Chairman: A.K. Singh, Assistant Professor, Agronomy, CPGS, CAU
Members: (i) A.S. Panwar, Principal Scientist, Division of Agronomy, ICAR-RC for NEH Region.
        (ii) Vishram Ram, Associate Professor, Farming System, CPGS, CAU.
        (iii) D. Thakuria, Associate Professor, Soil Microbiology, CPGS, CAU.
Studies on weed management practices in transplanted rice (Oryza sativa L.)

Author: Tage Obing
Submitted On: 08 November 2012

A field experiment was conducted at the Water Management Field, ICAR Research Complex for NEH region, Umiam, Meghalaya during kharif of 2011 to study the weed management practices in transplanted rice (Oryza sativa L.). The experiment was laid out in randomized block design with three replications. Weedy check (T₁), mechanical weeding (cono weeder) at 20 and 40 DAT (T₂), closer spacing (15 cm x 15 cm) + butachlor 1.5 kg ha⁻¹ (T₃), butachlor 1.5 kg ha⁻¹ + 2,4-D 0.75 kg ha⁻¹ (T₄), closer spacing (15 cm x 15 cm) + pretilachlor 0.75 kg ha⁻¹ (T₅), pretilachlor 0.75 kg ha⁻¹ + 2,4-D 0.75 kg ha⁻¹ (T₆), fenoxaprop 60 g ha⁻¹ + 2,4-D 0.75 kg ha⁻¹ (T₇) and hand weeding at 20 and 40 DAT (T₈) were the eight treatments employed. The results revealed that the most abundant weeds in the field were Marsilea minuta, Paspalum sp., Echinochloa crus-galli and Cyperus iria. Hand weeding at 20 and 40 DAT was found to be the best treatment in reducing weed density, weed growth and nutrient uptake by weeds and in terms of enhancing crop growth, nutrient content and uptake by crop, yield parameters, and yield of the crop. Among other treatments, weeding with cono weeder (4.33 t ha⁻¹) and closer spacing (15 cm x 15 cm) + pretilachlor 0.75 kg ha⁻¹ (4.31 t ha⁻¹) yielded higher grain yield than other treatments and were at par. Highest gross and net return was realized with hand weeding (Rs. 49424 ha⁻¹) and closer spacing (15 cm x 15 cm) + pretilachlor @ 0.75 kg ha⁻¹ (Rs. 14896 ha⁻¹), respectively. Highest benefit: cost ratio (2.03) was recorded with closer spacing (15 cm x 15 cm) + pretilachlor @ 0.75 kg ha⁻¹ and was at par with weeding with cono weeder (1.97). All the treatments performed significantly better than the weedy check in all aspects.

Advisory Committee

Chairman: D.J Rajkhowa, Principal Scientist, Division of Natural Resource Management, ICAR – RC for NEH Region.

Members: (i) D Hazarika, Sr. Scientist, Division of Natural Resource Management, ICAR – RC for NEH Region.

(ii) Anup Das, Principal Scientist, Division of Natural Resource Management, ICAR – RC for NEH Region.

(iii) A.K Singh, Assistant Professor, Agronomy, CPGS, CAU.
Effect of planting pattern and organic nutrient sources on performance of maize – cowpea intercropping system

Author: Vikram Kumar
Submitted On: 28th August 2014

To evaluate the effect of planting pattern and organic nutrients sources on maize and cowpea in an intercropping system, a field experiment was conducted on research farm of the College of Post Graduate Studies (Central Agricultural University), Umiam Meghalaya in split plot design with three replications. The treatment consists of four planting pattern (Sole maize, Sole cowpea, 1:1 maize + cowpea and 2:2 paired row maize + cowpea) and four nutrient sources (inorganic, FYM, ambrosia weed biomass and 50% through FYM + 50% through ambrosia weed biomass) allocated to main and sub plots, respectively.

The growth parameters of both the crops did not vary significantly due to planting patterns except for dry matter accumulation in maize at harvest and plant height of cowpea at 60 days after sowing (DAS). Cob length, grains per cob and grain weight per cob in maize differed significantly when sole maize being at par with paired row planted maize recorded their significantly higher values over the 1:1 intercropped maize with cowpea. Highest grain, stover and biological yield of maize was also reported from sole maize which was at par with paired row planted maize but significantly higher over the maize intercropped in 1:1 planting pattern with cowpea. Uptake of Nitrogen (N), Phosphorous (P) and Potassium (K) in grain, stover of maize and their total also differed significantly and follow the trend of grain yield (t ha-1) except for P uptake in stover when all treatments of planting pattern were at par. All the growth parameters and yield attributes of maize also differed significantly due to application of various sources of plant nutrients except for plant height at 30 DAS, crop growth rate (CGR) and relative growth rate (RGR) during 30-60 DAS and cobs per plant and cob length. Maximum grain yield in maize was recorded from inorganic nutrient source which was at par with combined nutrient application through farmyard manure (FYM) and ambrosia but significantly superior to grain yield recorded at sole nutrient source of either of the ambrosia or FYM. Maximum stover and biological yield was also recorded from inorganic nutrient source which was at par to these yields recorded at combined nutrient application through ambrosia and FYM and sole nutrient through ambrosia but significantly higher over the FYM as sole nutrient source. Uptake of N, P and K in grain and stover and their total in maize followed the trend of grain yield due to various sources of plant nutrients. Among the yield attributes of cowpea, plant population at harvest, pods per plant and pod weight per plant differed significantly when sole cowpea being at par with paired row cowpea recorded their superiority over 1:1 intercropped cowpea with maize. However, pod, haulm and biological yields (t ha-1) of cowpea were significantly higher in sole planted cowpea over both the intercropped planting pattern which was at par between them. Uptake of N, P and K in pods and haulm and their total also followed the trends of cowpea yield. Among nutrient sources, maximum pod and biological yield of cowpea was recorded from inorganic nutrient source which was significantly superior to all the organic sources those were
at par between themselves. The effect of nutrient sources on nutrient uptake was also in similar line on yields.

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       (ii) N.J. Singh, Assistant Professor, Soil Science, CPGS, CAU
       (iii) Lala I.P. Ray, Assistant Professor, Soil and Water Engineering, CPGS, CAU.